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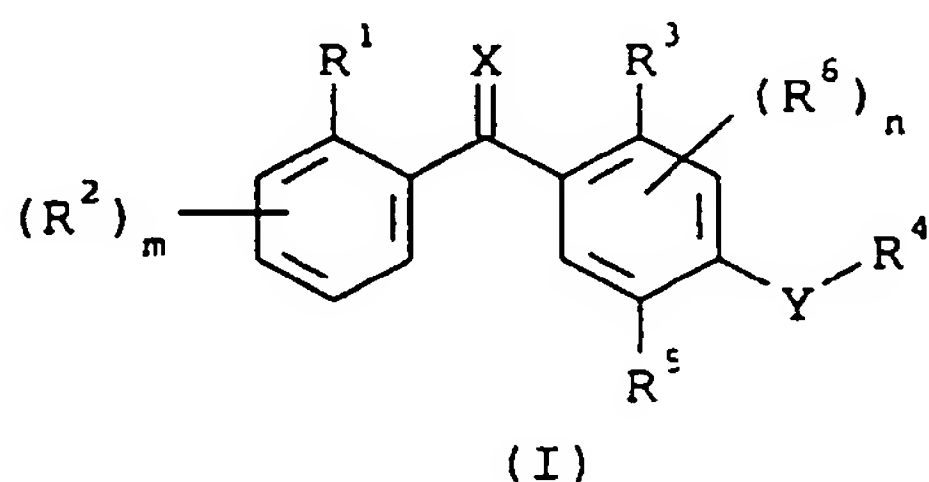
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(54) Fungicidal methods, compounds and compositions containing benzophenones

(57) There is provided a method for the control of phytopathogenic fungi and disease caused thereby which comprises contacting said fungi with a fungicidally effective amount of a benzophenone compound of formula I

There are further provided benzophenone compounds of formula Ia which are useful as fungicidal agents and compositions useful for the protection of plants from the damaging effects of phytopathogenic fungi and fungal disease.



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Description

BACKGROUND OF THE INVENTION

Food production relies upon a variety of agricultural technologies to ensure the growing population's dietary needs remain affordable, nutritious and readily available on grocery store shelves. Fungicides are one of these agricultural technologies which are available to the world community. Fungicides are agrochemical compounds which shield crops and foods from fungus and fungal diseases. Crops and food are constantly threatened by a variety of fungal organisms, which, if left uncontrolled, can cause ruined crops and devastated harvests.

In particular, ascomycetes, the causative agent for powdery mildew diseases are an ever-present threat especially to cereal and fruit crops. However, applications of fungicidal agents at disease control rates can cause phytotoxic damage to the target plants.

Therefore it is an object of this invention to provide a method to control phytopathogenic fungus without causing concurrent phytotoxic damage to the host plant.

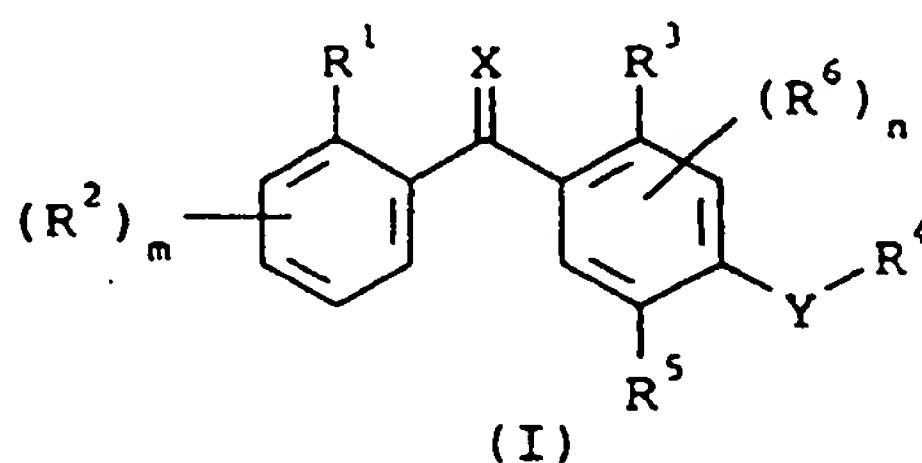
It is another object of this invention to provide an effective and safe method for the protection of important agronomic crops from the damage and loss caused by a phytopathogenic fungal infection and the disease caused thereby.

It is a further object of this invention to provide benzophenone fungicidal agents and fungicidal compositions comprising a benzophenone compound.

These and other objects and features of the invention will become apparent from the detailed description provided hereinbelow.

SUMMARY OF THE INVENTION

The present invention provides a method for the control of a phytopathogenic fungus or a disease caused thereby which comprises contacting said fungus with a fungicidally effective amount of a benzophenone compound of formula I



wherein R¹ represents a halogen atom, an optionally substituted alkyl or alkoxy group, a cyano or a nitro group; m is 0 or an integer of 1, 2, 3 or 4; R² independently represents a halogen atom, an optionally substituted alkyl or alkoxy group, a nitro group or when R¹ and R² are attached to adjacent carbon atoms, R¹ and one R² may be taken together to represent -CH=CH-CH=CH- or optionally substituted alkylene or oxyalkyleneoxy, such as O-CF₂-O; R³ represents hydrogen, halogen, an optionally substituted alkyl, alkoxy, alkenyl, alkylthio, alkylsulphinyl, alkylsulphonyl, cyano, carboxy, hydroxy, nitro, or an optionally substituted amino group; R⁴ represents a hydrogen atom or an optionally substituted alkyl or acyl group; R⁵ represents a hydrogen, halogen, an optionally substituted alkyl, alkoxy, alkenyloxy, alkynyloxy, alkylthio, cycloalkyl, cycloalkyloxy, a nitro, hydroxy, phenoxy, trialkylsilyloxy group, -ONa, -OK, -OC(O)R⁷, -OCHR⁸C(O)R⁷, -OC(O)NR⁸R⁹, -OS(O)₂R⁸, -OS(O)₂NR⁸R⁹, -OP(X¹)(OR⁸)OR⁹, -OP(X¹)(R⁸)R⁹, -S(O)R⁸, -S(O)₂R⁸, or R⁴ and R⁵ may be taken together to represent an optionally substituted alkylene or alkyleneoxy chain; n is 0, or an integer of 1 or 2; R⁶ independently represents a halogen atom, an optionally substituted alkyl, alkenyl, alkynyl, alkoxy, alkenyloxy, alkynyloxy, cycloalkyl, cycloalkoxy, hydroxy, -OC(O)R¹⁰ group, or when R⁵ and R⁶ are attached to adjacent carbon atoms, R⁵ and one R⁶ may be taken together to represent -CH=CH-CH=CH- or an optionally substituted oxyalkyleneoxy chain; R⁷ represents a hydrogen atom or an optionally substituted alkyl, alkoxy or aryl group; R⁸, R⁹ and R¹⁰ independently represent a hydrogen atom, an alkyl, aryl or aralkyl group, or R⁸ and R⁹ may be taken together to represent an alkylene chain optionally interrupted by an oxygen or nitrogen atom; X represents an oxygen atom, a sulphur atom or a group NOR; X¹ represents an oxygen or sulphur atom; Y represents an oxygen or sulphur atom or a sulphonyl or sulphinyl group; and R represents a hydrogen atom or an optionally substituted alkyl, aralkyl, aryl or acyl group.

As used in the specification and claims, the term "benzophenone" encompasses oxime derivatives of benzophenone (X=NOR), benzothiophenones (X=S) and the underivatized benzophenone ketone (X=O).

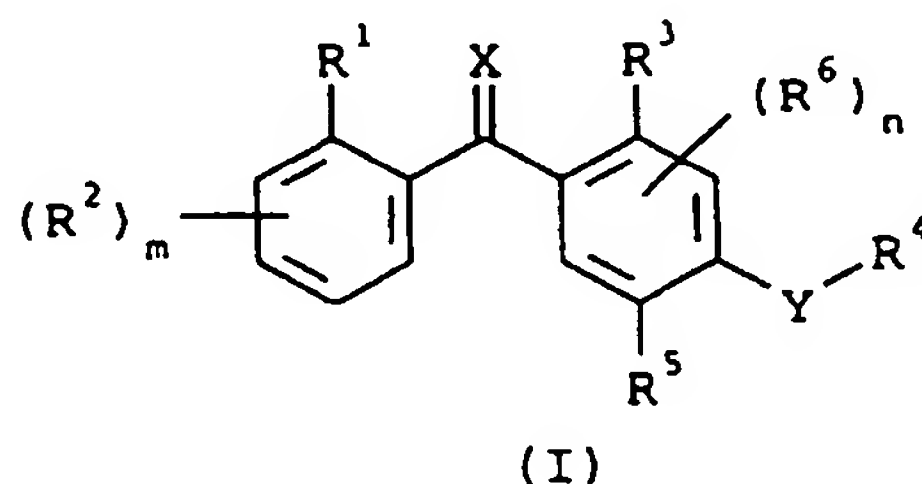
The present invention also provides crop protection methods, fungicidal benzophenone compounds of formula Ia, methods of preparation of said benzophenone compounds and fungicidal compositions comprising at least one formula

I or Ia compound and an agriculturally acceptable carrier.

DETAILED DESCRIPTION OF THE INVENTION

Huge economic losses have resulted from the devastation and damage of important agronomic and horticultural crops caused by fungal infection and infestation. Pest management strategies, field resistance, and virulent strains have all contributed to agriculturalists' concerns for combatting phytopathogenic fungal disease. In particular, ascomycetes, the causative agents for powdery mildew diseases continues to be a serious concern in cereal crop and fruit production. Further, in a variety of fungicidal agent applications concomitant phytotoxic injury to the host plant may be observed.

It has now been found that benzophenone compounds of formula I are highly effective fungicidal agents and are particularly effective for controlling mildew diseases such as powdery mildew. Compounds of formula I useful in fungus control methods are those benzophenones having the structure



wherein X, Y, R¹, R², R³, R⁴, R⁵, R⁶, m and n are described hereinabove.

Alkyl as a substituent or as a part of other substituents, such as alkoxy or alkylthio may be straight-chain or branched and may contain up to eighteen, preferably up to 14, and especially up to 10, carbon atoms, individual examples including: methyl, ethyl, propyl, butyl, pentyl, hexyl, etc. as well as their isomers such as isopropyl, isobutyl, tertiary-butyl, isopentyl, and the like. Lower alkyl or alkoxy groups have from 1 to 10 carbon atoms. A cycloalkyl moiety as a substituent or as a part of other substituents suitably contains from 3 to 10, preferably from 3 to 6, carbon atoms. An alkenyl or alkynyl group suitably has from 2 to 6, preferably from 2 to 4 chain members, for example, ethenyl, propenyl, allyl, butenyl and the like as well as for chains with more than one double bond such as pentadienyl and the like. An alkylene chain usefully has 1 to 5, preferably 1 to 4, members.

An acyl group is formally formed by the removal of hydroxyl from a carboxyl group, and is used herein to include formyl and optionally substituted alkylcarbonyl and arylcarbonyl groups.

A halogen atom represents fluorine, chlorine, bromine and iodine, preferably chlorine. Preferred haloalkyl moieties are difluoromethyl and trifluoromethyl.

Optionally substituted moieties may be unsubstituted or have from one up to the maximal chemically possible number of substituents. Optional substituents may be any of those customarily employed in the development of biocidal compounds, and/or the modification of such compounds to influence their activity, persistence, penetration and any other property. Specific examples of such substituents include halogen, especially fluorine, chlorine or bromine, nitro, cyano, hydroxy, carboxy, amino, alkyl- or aralkylamino, dialkylamino, cycloalkylamino, piperidyl, piperidinyl, morpholinyl, carbamoyl, aryl- or benzylcarbamoyl, mono- or dialkylcarbamoyl, morpholinocarbonyl, trialkylsilyl, alkyl, alkenyl, alkynyl, alkoxy, alkoxyalkyl, alkoxyalkoxy, cycloalkyl, cycloalkoxy, acyl, optionally substituted benzoyl, benzoxazolyl, alkoxycarbonyl, optionally substituted pyridyl, phenoxy or naphthyl, phenyl or phenyl substituted by one or more substituents selected from the group comprising halogen, alkyl, alkoxy, alkoxyalkyl, alkoxyalkoxy, alkylthio, phenylthio, benzylthio, aralkoxy, hydroxy, carboxy, carbalkoxy, cyano, optionally substituted amino, nitro, trifluoromethyl, trifluoromethoxy and the like. Alkyl moieties of such optional substituents may have from 1 to 6 carbon atoms, preferably 1 or 2 carbon atoms. If a substituted group mentioned herein does contain two or more substituents, such substituents may be identical or different.

The benzophenone compounds according to formula I are oils, gums, or, predominantly, crystalline solid materials and possess valuable fungicidal properties. For example, they can be used in agriculture, or related fields such as horticulture and viticulture, for the control of phytopathogenic fungi, especially ascomycetes, and powdery mildew disease such as *Erysiphe graminis*, *Podosphaera leucotricha*, *Uncinula necator* and the like. Said benzophenone compounds possess a high fungicidal activity within a wide concentration range and may be used in agriculture without harmful phytotoxic effects.

Preferred formula I compounds useful in the method of invention are those in which R¹ represents a halogen atom

or an optionally substituted alkyl or alkoxy group; m is 0 or an integer of 1, 2 or 3; and R² independently represents a halogen atom or an optionally substituted alkyl or alkoxy group; or R¹ and R² together represent -CH=CH-CH=CH-, oxyalkyleneoxy, difluorooxymethyleneoxy or alkylene; R³ represents a halogen atom, an optionally substituted alkyl, alkenyl, alkylthio or alkylsulphonyl group, a nitro group, or an optionally substituted amino group; R⁵ represents a hydrogen atom, an optionally substituted alkyl, alkoxy, alkenyloxy, alkynyloxy, cycloalkoxy or alkylthio group, a hydroxy group, a trialkylsilyloxy group, or a -OC(O)R⁷, -OCHR⁸C(O)R⁷, -OC(O)NR⁸R⁹, NH-CO-R⁷, -OS(O)₂R⁸ or -OS(O)₂NR⁸R⁹ group; or R⁴ and R⁵ together represent an optionally substituted alkyleneoxy chain; n is 0 or the integer 1; R⁶ represents an optionally substituted alkyl, alkenyl, alkynyl, alkoxy, alkenyloxy, alkynyloxy, cycloalkyl or cycloalkoxy group or a -OC(O)R¹⁰ group; R⁷ represents a hydrogen atom or an alkyl or alkoxy group; X represents an oxygen atom or an NOR group; and R represents a hydrogen atom or an optionally substituted alkyl group.

Good control of phytopathogenic fungi is obtained with a fungicidally effective amount of a compound of formula I wherein R¹ represents a halogen atom or an optionally substituted lower alkyl group; m is an integer of 1 or 3; R² independently represents a halogen atom or an optionally substituted lower alkyl group; R³ represents a halogen atom, an optionally substituted alkyl or alkenyl group, or an optionally substituted amino group; R⁵ represents an optionally substituted alkyl, alkoxy, alkenyloxy, alkynyloxy, cycloalkoxy or alkylthio group or R⁴ and R⁵ may be taken together to represent an optionally substituted alkyleneoxy chain; n is 0 or the integer 1; R⁶ represents an optionally substituted alkyl, alkenyl, alkynyl, alkoxy, alkenyloxy, alkynyloxy, cycloalkyl or cycloalkoxy group or a -OC(O)R¹⁰ group; R⁷ represents an alkyl or alkoxy group; X represents an oxygen atom or NOR group; Y represents an oxygen atom; and R represents hydrogen or C₁-C₄alkyl.

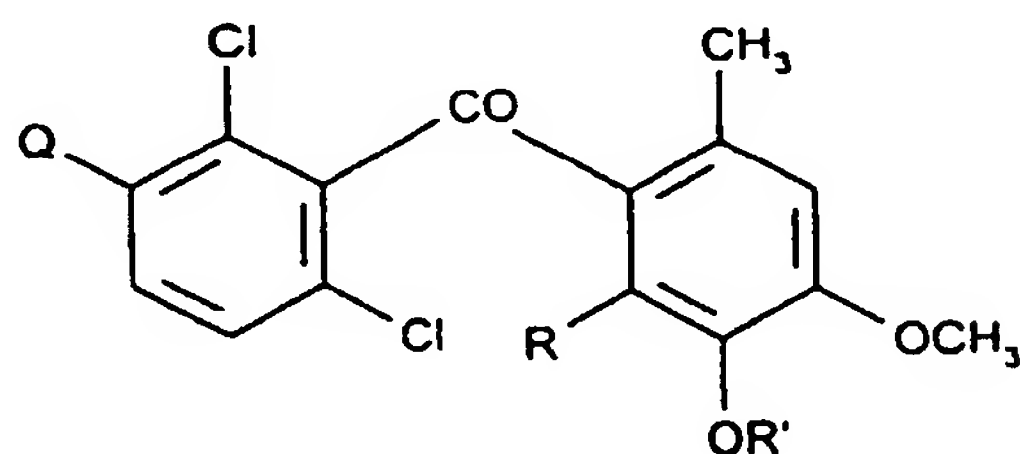
Especially preferred are those formula I compounds in which R¹ represents a halogen atom or C₁-C₄alkyl group; R² independently represents a halogen atom or C₁-C₄alkyl group; R³ represents a halogen atom or an optionally substituted C₁-C₄alkyl group; R⁴ represents an optionally substituted C₁-C₄alkyl group; R⁵ represents an optionally substituted lower alkyl, alkoxy, alkenyloxy, alkynyloxy or cycloalkoxy group; R⁶ represents an optionally substituted C₁-C₆ alkoxy, alkenyloxy, alkynyloxy or cycloalkoxy group

Effective control of phytopathogenic fungi may be achieved, for example, with a fungicidally effective amount of one or more of the following compounds:

2,3,5,6-tetramethyl-4',5',6'-trimethoxy-2'-methylbenzophenone;
 2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone-O-methyloxime;
 2,6-dichloro-5'-t-butoxy-4'-methoxy-2'-methylbenzophenone;
 2,6-dichloro-5',6'-di-n-butoxy-4'-methoxy-2'-methylbenzophenone;
 2'-allyloxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;
 2'-benzyloxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;
 2'-butoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;
 2'-cyclohexylmethoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;
 2'-benzoylmethoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;
 2'-cyclopentylmethoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;
 2,6-dichloro-2',3',4'-trimethoxy-6'-methylbenzophenone;
 2,6-dichloro-2'-ethoxy-3',4'-dimethoxy-6'-methylbenzophenone;
 2,6-dichloro-2'-heptyloxy-3',4'-dimethoxy-6'-methylbenzophenone;
 2,6-dichloro-2'-hexyloxy-3',4'-dimethoxy-6'-methylbenzophenone;
 2,6-dichloro-3',4'-dimethoxy-2'-(2-methoxy-ethoxy)-6'-methylbenzophenone;
 2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-(3-methylbutoxy)benzophenone;
 2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-(prop-2-ynyloxy)benzophenone;
 2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-pentyloxybenzophenone;
 2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-propoxybenzophenone;
 2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone;
 2,6-dichloro-4'-methoxy-2'-methyl-5'-(3-methylbutoxy)benzophenone;
 2,6-dichloro-4'-methoxy-2'-methyl-5'-(prop-2-ynyloxy)benzophenone;
 2,6-dichloro-4'-methoxy-2'-methyl-5'-(octyloxy)benzophenone;
 2,6-dichloro-4'-methoxy-2'-methyl-5'-(pentyloxy)benzophenone;
 2,6-dichloro-4'-methoxy-2'-methyl-5'-propoxybenzophenone;
 2,6-dichloro-4'-methoxy-2'-methyl-5'-trimethylsilylmethoxybenzophenone;
 2,6-dichloro-5'-(1-ethyl-propoxy)-4'-methoxy-2'-methylbenzophenone;
 2,6-dichloro-5'-difluoromethoxy-4'-methoxy-2'-methylbenzophenone;
 2,6-dichloro-5'-ethoxy-4'-methoxy-2'-methylbenzophenone;
 2,6-dichloro-5'-heptyloxy-4'-methoxy-2'-methylbenzophenone;
 2,6-dichloro-5'-hexyloxy-4'-methoxy-2'-methylbenzophenone;
 2,6-dichloro-5'-isobutoxy-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-5'-isopropoxy-4'-methoxy-2'-methylbenzophenone;
 5'-butoxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;
 5'-cyclohexylmethoxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;
 5'-cyclohexyloxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;
 5'-cyclopentyloxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;
 5'-cyclopropylmethoxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone; or
 5'-decyloxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone.

Compounds of particular fungicidal use are those compounds of Formula I B.



(I B)

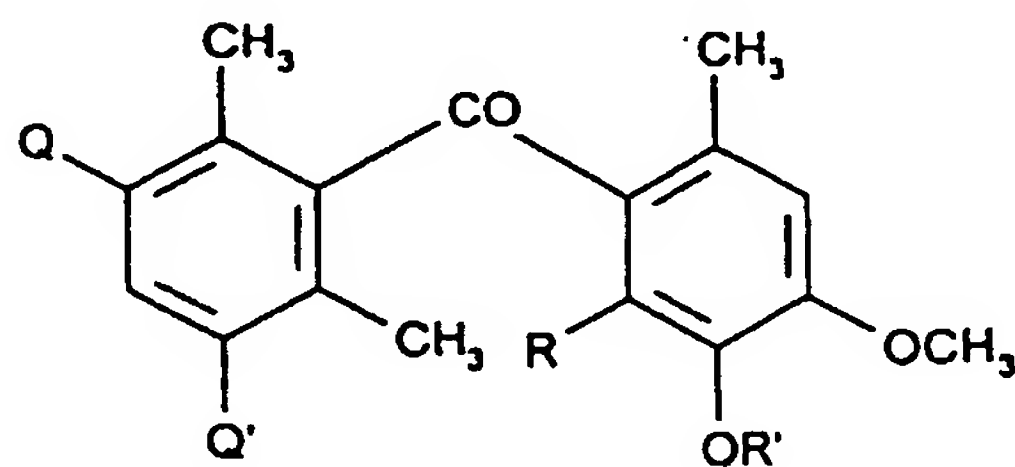
wherein Q represents a hydrogen or a chlorine atom; R represents a hydrogen atom, a C₃-C₈ cycloalkoxy group or a C₁-C₈-alkoxy group optionally substituted with one or more fluorine atoms, or one phenyl, phenoxy, phenylthio or benzyloxy group, wherein the phenyl moiety may be substituted by halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl or trifluoromethoxy; and

R' represents hydrogen or C₁-C₁₀-alkyl optionally substituted with one or more halogen, C₁-C₄-alkoxy, phenyl, phenoxy or phenylthio groups, wherein the phenyl moiety may be substituted by halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl or trifluoromethoxy,

with the proviso, that when Q and R represent hydrogen then R' must be other than methyl.

Preferred compounds of formula I B are those wherein Q represents a hydrogen or a chlorine atom; R represents a hydrogen atom, a C₅-C₇-cycloalkoxy group, a C₁-C₆-alkoxy group optionally substituted by one or more fluorine atoms, or one phenyl, phenoxy, phenylthio or benzyloxy group, wherein the phenyl moiety may be substituted by halogen, methyl, methoxy, trifluoromethyl or trifluoromethoxy; and R' represents hydrogen or C₁-C₈-alkyl optionally substituted by fluorine, chlorine, C₁-C₄-alkoxy, phenyl, phenoxy or phenylthio, wherein the phenyl moiety may be substituted by fluorine, chlorine, bromine, methyl, methoxy, trifluoromethyl or trifluoromethoxy.

Further compounds of particular value are those compounds of Formula I C.



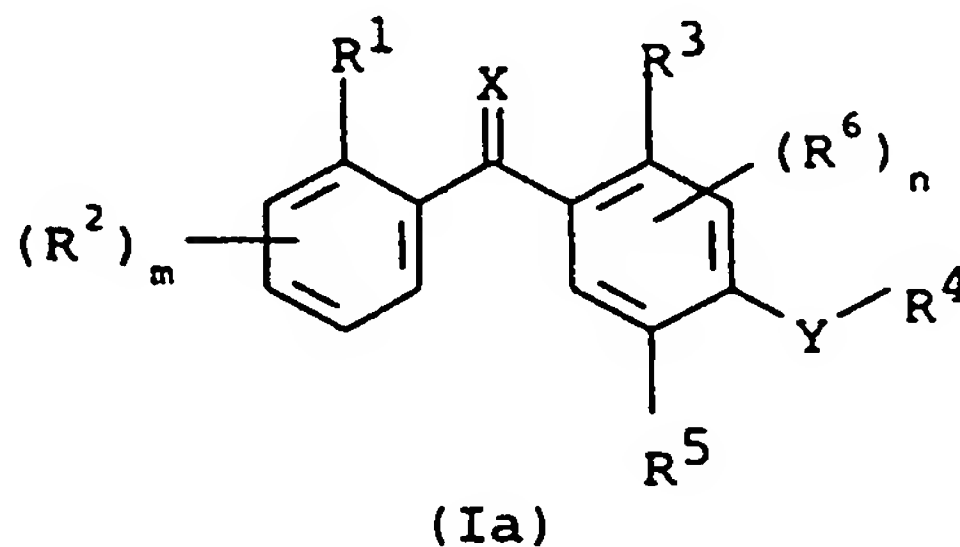
(I C)

wherein Q and Q' independently represent a hydrogen atom or methyl group; R represents a hydrogen atom, a C₃-C₈-cycloalkoxy group or a C₁-C₈-alkoxy group optionally substituted with one or more fluorine atoms, a phenyl, phenoxy, phenylthio or benzyloxy group, wherein the phenyl moiety may be substituted with one or more halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl or trifluoromethoxy groups; and R' represents hydrogen or C₁-C₁₀-alkyl optionally substituted with one or more halogen, C₁-C₄-alkoxy, phenyl, phenoxy or phenylthio groups, wherein the phenyl moiety may be substituted by one or more halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl or trifluoromethoxy groups.

Preferred compounds of formula I C are those compounds, wherein Q and Q' independently represent a hydrogen atom or a methyl group; R represents a hydrogen atom, a C₅-C₇-cycloalkoxy group, a C₁-C₆-alkoxy group optionally substituted with one or more fluorine atoms, one phenyl, phenoxy, phenylthio or benzyloxy group, wherein the phenyl moiety may be substituted by fluorine, chlorine, bromine, methyl, methoxy, trifluoromethyl or trifluoromethoxy; and R' represents hydrogen or C₁-C₈-alkyl optionally substituted by one or more fluorine, chlorine, C₁-C₄-alkoxy, phenyl, phe-

noxy or phenylthio groups, wherein the phenyl moiety may be substituted with one or more bromine, methyl, methoxy, trifluoromethyl or trifluoromethoxy groups.

The present invention also provides new benzophenone compounds of formula Ia

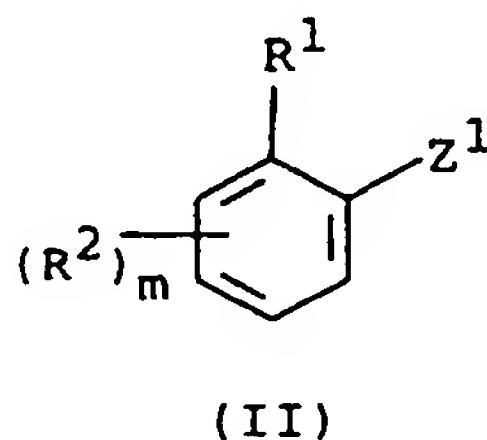


wherein R¹ represents a halogen atom, an optionally substituted alkyl group or a cyano group; m is an integer of 2, 3 or 4; R² independently represents a halogen atom, an optionally substituted alkyl or alkoxy group or when R¹ and R² are on adjacent carbon atoms, R¹R² together represent -CH=CH-CH=CH- or an optionally substituted alkylene or oxyalkyleneoxy group; R³ represents a hydrogen or halogen atom, an optionally substituted alkyl, alkoxy, alkenyl, alkylthio, alkylsulphinyl, alkylsulphonyl, cyano, carboxy, hydroxy, nitro, or an optionally substituted amino group; R⁴ represents an optionally substituted alkyl or acyl group; R⁵ represents a halogen atom, an optionally substituted alkoxy, alkenyloxy, alkynyloxy, alkylthio, cycloalkyl, cycloalkyloxy, trialkylsilyloxy, -ONa, -OK, -OC(O)R⁷, -OCHR⁸C(O)R⁷, -OC(O)NR⁸R⁹, -OS(O)₂R⁸, -OS(O)₂NR⁸R⁹, -OP(X¹)(OR⁸)OR⁹, -OP(X¹)(R⁸)R⁹, -S(O)R⁸ or -S(O)₂R⁸ group or R⁴ and R⁵ may be taken together to represent an optionally substituted alkylene or alkyleneoxy chain; n is 0 or an integer of 1 or 2; R⁶ independently represents an optionally substituted alkoxy group, a hydroxy group or a -OC(O)R¹⁰ group when attached to adjacent carbon atoms, or R⁵ and one R⁶ may be taken together to represent -CH=CH-CH=CH- or an optionally substituted oxyalkyleneoxy chain; R⁷ represents a hydrogen atom or an optionally substituted alkyl, aryl or alkoxy group; R⁸, R⁹ and R¹⁰ independently represent a hydrogen atom or an alkyl group, or R⁸ and R⁹ may be taken together to represent an alkylene chain optionally interrupted by an oxygen or nitrogen atom; X represents an oxygen atom, a sulphur atom or an NOR group; X¹ represents an oxygen or sulphur atom; Y represents an oxygen or sulphur atom or a sulphonyl or sulphinyl group; and R represents a hydrogen atom or an optionally substituted, alkyl, aralkyl, aryl or acyl group, with the provisos that when X represents an oxygen or sulphur atom and:

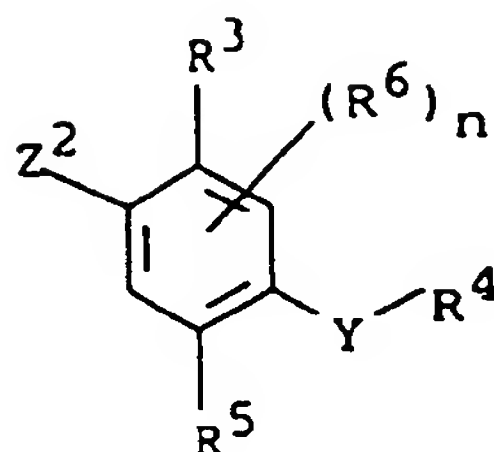
- (i) when R¹ represents a halogen atom, then (R²)_m must be other than a halogen atom or no more than one alkyl or alkoxy group.
- (ii) when R¹ represents an alkyl group, then R² must be other than alkyl;
- (iii) when m is 1, then R² must be other than an alkoxy group;
- (iv) when R³ represents an alkenyl group, then R³ cannot be substituted with an alkoxy or acyl group;
- (v) when R³ represents a haloalkyl group, then R¹ and R² must be other than a haloalkyl group; and
- (vi) when Y represents an oxygen atom, then R³ and R⁵ must be other than a hydrogen atom and n must be 1 or 2.

The compounds of formula I can be prepared by conventional methods.

Thus the compounds having formula I (including those of formula Ia) may be prepared by a process which comprises reacting a compound of formula II



with a compound of formula III



(III)

wherein R^1 , R^2 , R^3 , R^4 , R^5 , R^6 , Y , m and n are as hereinbefore defined and one of Z^1 and Z^2 represents a hydrogen atom and the other represents the group $COCl$; or one represents a magnesium halide group $MgHal$, wherein Hal is a halogen, preferably bromine or iodine, atom, and the other represents $COCl$ or an aldehyde or nitrile group, followed in the last two cases by oxidation or hydrolysis, respectively, and optionally followed by further derivatization.

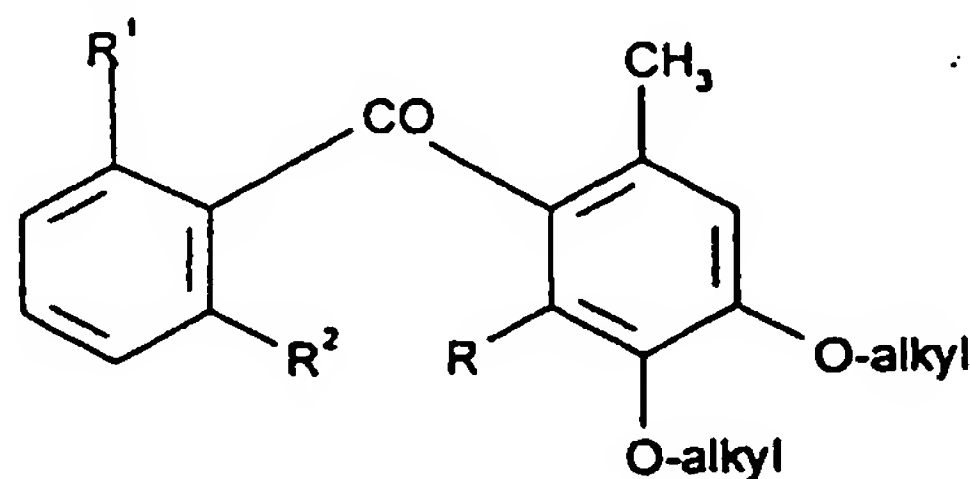
The starting materials of formula II and III are known products, and may themselves be prepared according to established methods or routine adaptations thereof. Substituents R^1 to R^9 which are not compatible with the selected reaction conditions may be introduced after formation of the benzophenone. They may be generated by known methods such as subsequent derivatization or substitution of a suitable group or by cleaving off a suitable protecting group.

When one of Z^1 and Z^2 is hydrogen and the other is $COCl$, the process is a Friedel Crafts reaction and is effected in the presence of a Lewis acid catalyst according to well-established procedures. Suitable catalysts include $FeCl_3$, $AlCl_3$, $SnCl_4$, $ZnCl_2$, $TiCl_4$, $SbCl_5$ and BF_3 , which may be in a molar equivalent amount (based on the acyl chloride). However, it is also possible to use lesser amounts of catalyst at elevated temperatures, suitably under reflux temperatures, preferred catalysts under these conditions being $FeCl_3$, I_2 , $ZnCl_2$, iron, copper, strong sulphonic acids such as F_3CSO_3H , and acidic ion exchange resins such as Amberlyst® 15 and Nafion®. The preferred catalyst is $FeCl_3$ in a 0.001 to 0.2 molar ratio at a temperature of about 50 to 180°C. The reaction can be carried out in a solvent inert under the reaction conditions, for example ethylene or methylene chloride, benzene, octane, decane or solvent mixtures, or in the absence of solvent, conveniently by employing one of the reactants in excess, e. g. in the range of 1:5 to 5:1. If $AlCl_3$ is being used, the molar ratio is preferably in the range of 0.5 to 2 and the suitable solvents are e.g. methylenechloride or ethylenechloride at a temperature usually between -10 and -70°C. If in the starting material R^3 is methyl and R_6 or one R_6 represents a 5-alkoxy group (formula III) ether cleavage is possible to give the 6-hydroxy compound which then can be derivatized according to usual methods.

If the compound of formula II represents 2,6-dichlorobenzoylchloride and the compound of formula III is 1,2,3-trialkoxy-5-alkylbenzene, the Friedel-Crafts reaction with $AlCl_3$ can be used to prepare different products dependent on the reaction conditions. In case of a molar amount of 0.5 to 2 of aluminiumchloride, a temperature of about 0 to 25°C and a solvent such as methylene or ethylene, the ether cleavage takes place in the 6-position (ortho position) of the compound of formula I within about 1 to 20 hours; at a higher temperature (about 40°C) with - if necessary - longer reaction times (between about 2 and 24 hours) ether cleavage can be performed in the 5-(meta)-position too.

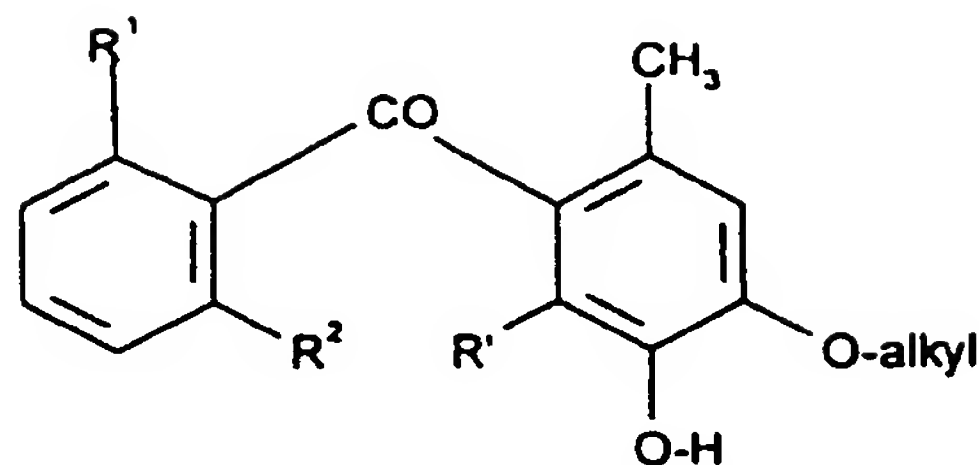
The processes described below can analogously be applied to other starting compounds, if desired.

Starting from compounds of formula



(VIII)

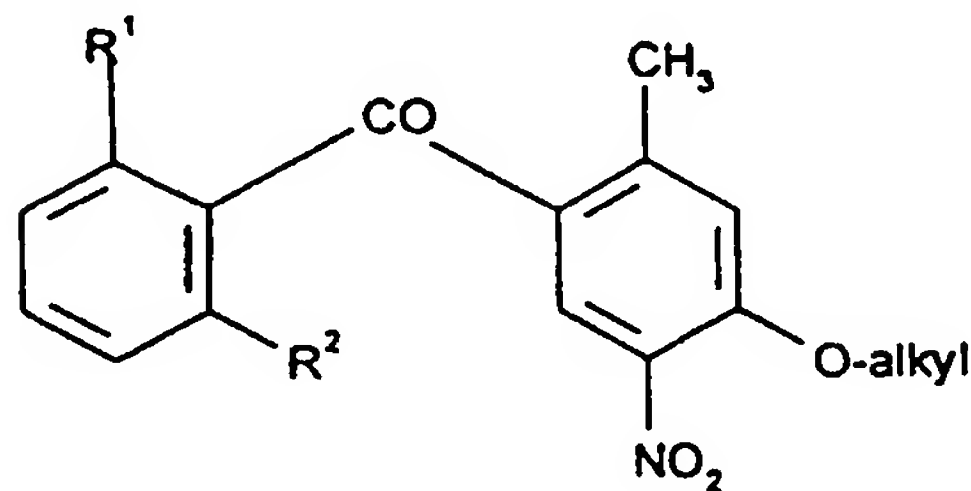
wherein R^1 , R^2 represent preferably Cl , CH_3 , R is H or O -alkyl and alkyl is preferably methyl, ether cleavage between about 50 and 100°C with HBr /acetic acid leads to compounds of formula



(IX)

wherein R¹ is H or OH.

Starting from a compound of formula



(X)

wherein R¹ and R² are defined as before, the cleavage of the O-alkyl group can be carried out with AlCl_3 (0.5-2 mol) in an inert solvent such as methylenechloride at about 20-50°C to give the corresponding OH compound.

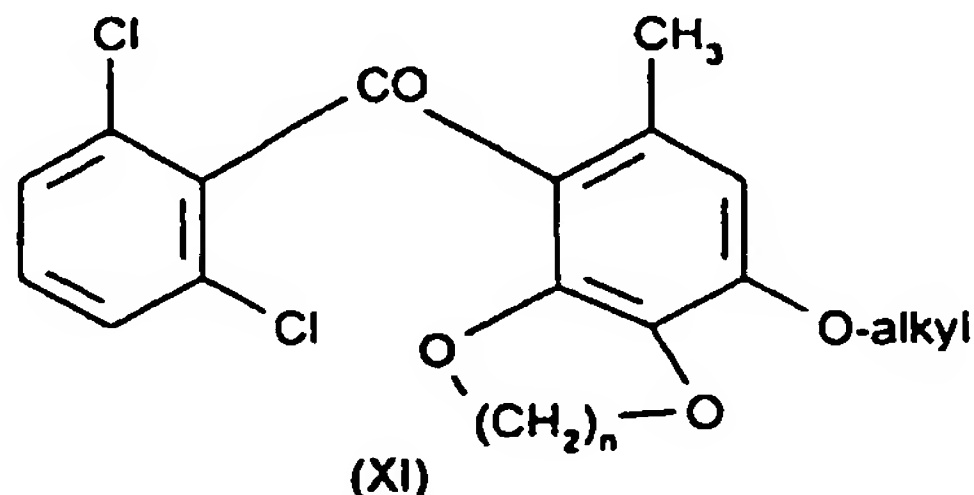
The alkylation of compounds of formula VIII, IX or the ether cleavage product received from X can be carried out according to usual methods.

Compounds of formula IX wherein R¹ is H can be reacted with an alkylhalogenide (wherein the alkyl moiety may be substituted) in a lower alcohol in the presence of a basic compound such as potassium carbonate at elevated temperatures (e.g. 60-150°C).

In case of hydroxy groups in other positions (as in VIII, R¹ = OH or in the reaction product received from X) a salt with a metal has to be produced by reacting the hydroxy compound with e.g. potassium hydroxide. The salt is then reacted with an optionally substituted alkyl halogenide in a polar solvent (e.g. dimethylformamide) in the absence of water.

Dialkylation of compounds of formula IX wherein R¹ is OH with the same optionally substituted alkyl groups can be carried out starting from the corresponding di-alkali, preferably di-sodium salt, which can be obtained from the dihydroxy compound and sodium hydride in an inert solvent (e.g. tetrahydrofuran), the salt is then reacted in an inert polar solvent (e.g. dimethylformamide) with an excess of the optionally substituted alkylhalogenide at a temperature between about 80 and 120°C.

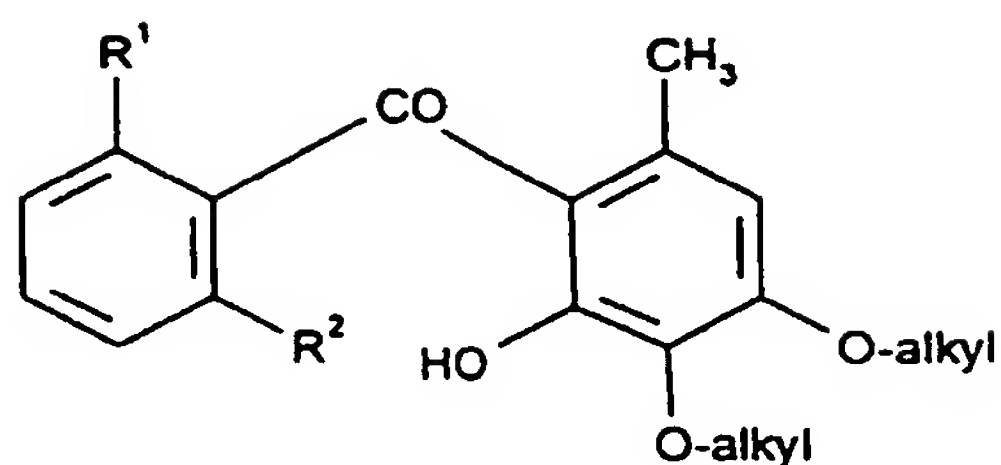
Dialkylation with a dihalogen compound of formula $\text{Hal}-(\text{CH}_2)_n-\text{Hal}$ (Hal = Cl, Br or I; $n = 1$ to 4) leads to cyclisation (compound XI; n as before) :



(XI)

The reaction of the dihydroxy compound IX (R¹=OH) with the dihalogen compound is carried out in the presence of an excess of potassium carbonate and of a small amount of copperoxide as catalyst at temperatures between about 10 and 50°C, preferably at room temperature.

To prepare acylated compounds a corresponding hydroxy compound, for example of formula XII

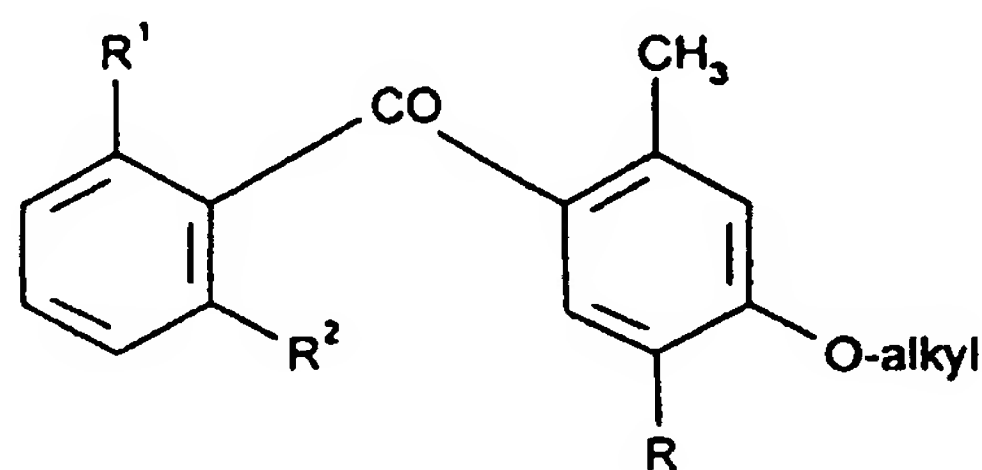


(XII)

wherein R_1 and R_2 are Cl or CH_3 , is reacted in form of its (e.g. potassium) salt in an inert polar solvent, such as dimethylformamide, with an optionally substituted acid chloride at a temperature between about 10 to 50°C.

Acylation of compounds of formula IX (with $R' = H$) can be carried out by heating that compound with an acid anhydride in the presence or without an inert solvent at temperatures between about 80 and 120°C.

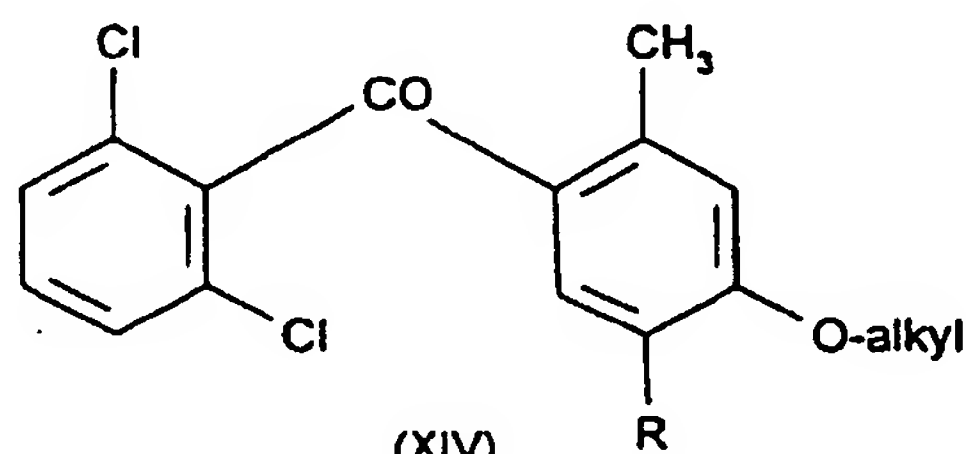
For the preparation of compounds of formula XIII,



(XIII)

wherein R represents a t-butoxy group, R^1 and R^2 are defined as before but preferably represent Cl, the corresponding hydroxy compound (XIII; $R = OH$) is dissolved in an inert solvent, the solution cooled to about -70°C and after addition of a catalytical amount of trifluoromethane sulfonic acid a stream of 2-methylpropene is bubbled into the mixture for 2 to 6 hours. After neutralizing the acid, the resulting t-butoxy compound can be isolated.

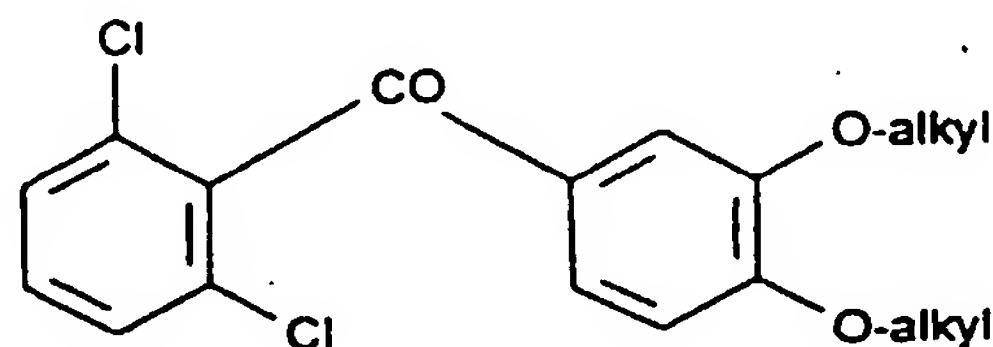
A 5-nitro compound of formula XIV



(XIV)

($R = NO_2$) can be prepared by nitration of the corresponding compound unsubstituted in the 5-position ($R = H$) with concentrated (65%) nitric acid at about 50 to 100°C.

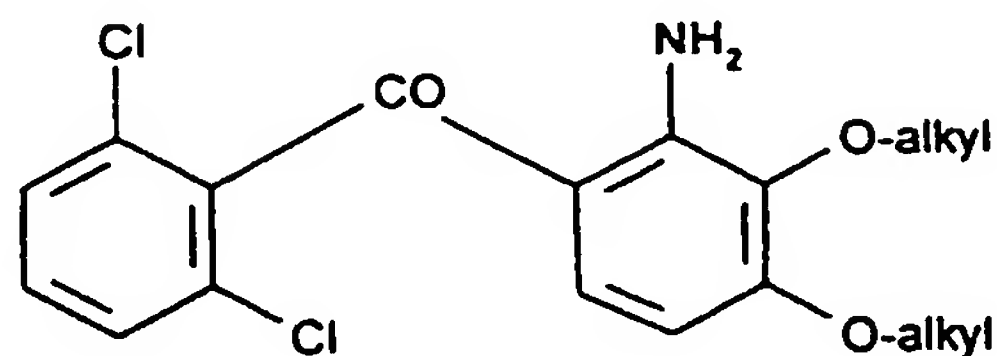
Nitration of compounds of formula XV



(XV)

in the 2-position can be carried out with concentrated (65%) nitric acid at about 30 to 60°C.

The resulting or otherwise prepared nitro compounds can be reduced to the corresponding amino compounds, e. g. of formula XVI



(XVI)

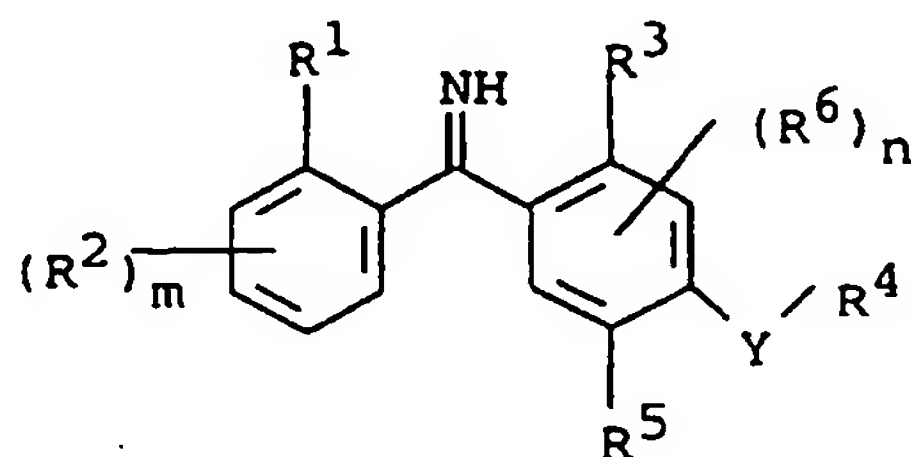
with excess powdered iron in a mixture of water/acetic acid 50:1 at elevated temperature (60 to 100°C).

Reaction of the amino compounds with excess formic acid at reflux temperature leads to formylation of the amino group.

Compounds of formula XIV (R=H) can be brominated in 5-position when the equimolar amount of bromine (e. g. in trichloromethane) is added dropwise to the solution of the compound in trichloromethane at 10 to 30°C.

Benzophenothiones (I; X = S) can be prepared from the corresponding benzophenones by heating them with phosphorus pentasulfide in an inert solvent to reflux temperature for 2 to 10 hours.

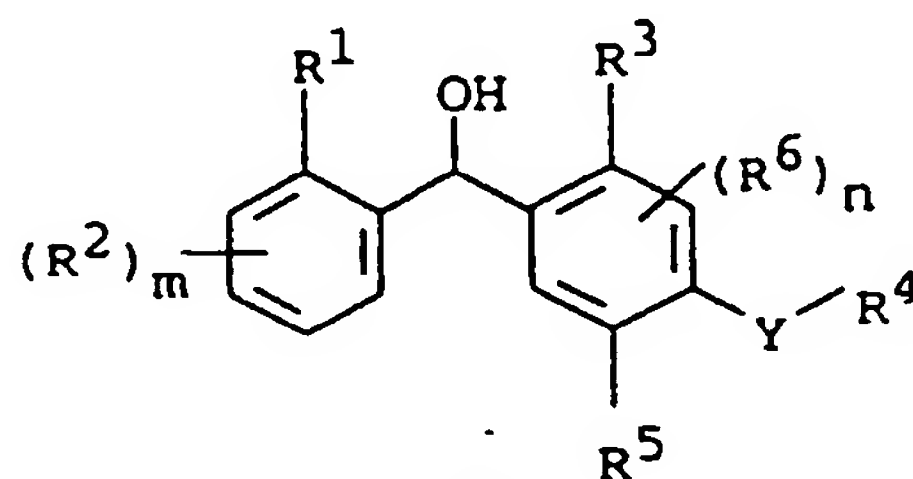
When the magnesium halide is reacted with a nitrile, i.e. the other group Z¹ or Z² (formulae II, III) represents CN, the immediate reaction product is an imine of formula IV:



(IV)

This intermediate is readily converted to the desired benzophenone derivatives of formula I wherein X is an oxygen atom by acid hydrolysis, suitably using mineral acids such as hydrochloric or sulphuric.

When magnesium halide is reacted with an aldehyde, i.e. the other group Z¹ or Z² represents CHO, the immediate reaction product is a tertiary alcohol of formula V:

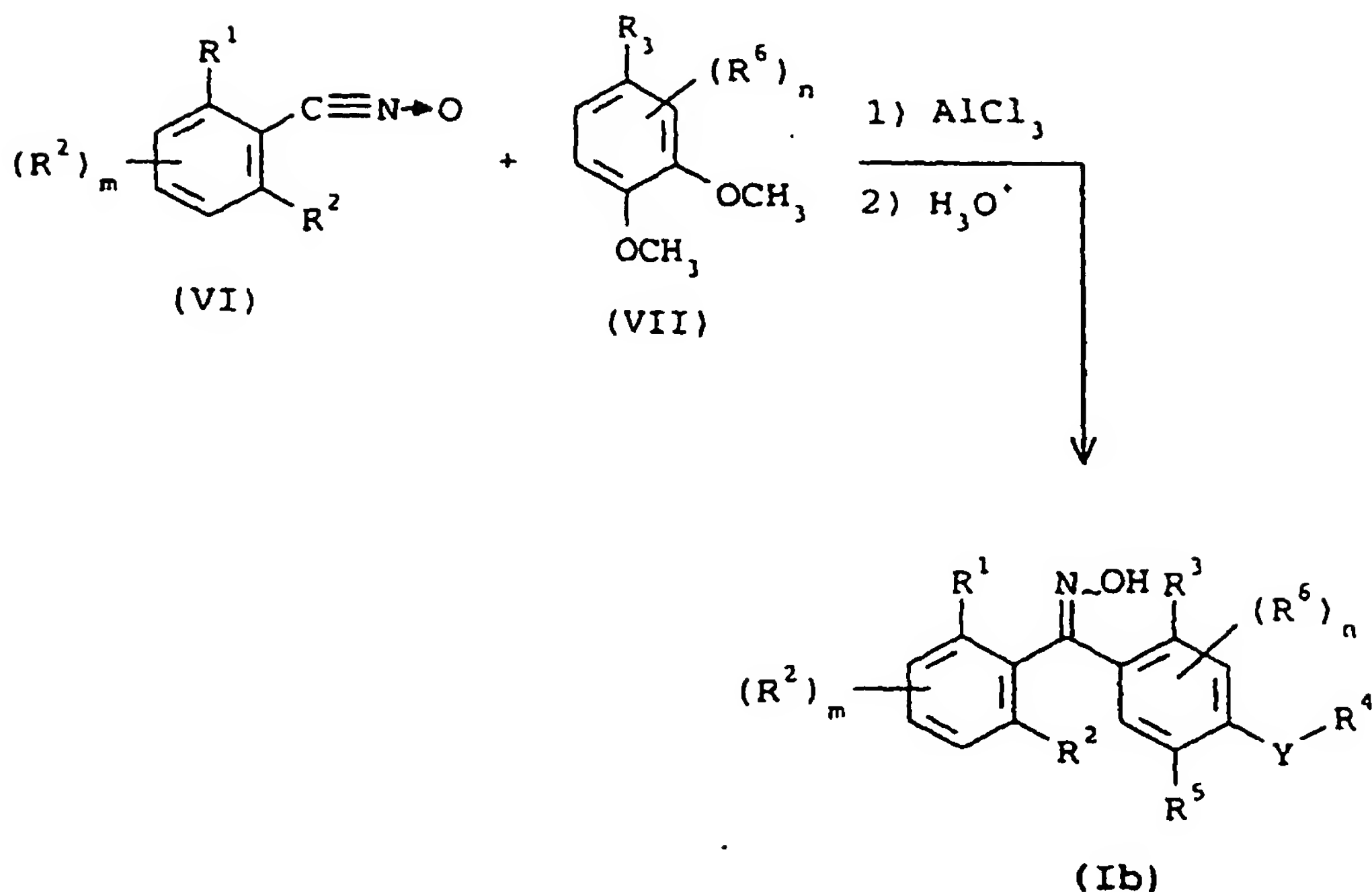


(V)

This formula V intermediate is readily converted to the desired benzophenone derivatives of formula I wherein X is an oxygen atom by oxidation, suitably using Mn(IV), Mn(VII), Ce(IV) or Cr(VI) derivatives, nitric acid or oxygen in the presence of a catalyst.

Certain oxime derivatives of formula I may be prepared by reacting the appropriately substituted nitrile oxide of formula VI with a suitable o-dimethoxybenzene of formula VII in the presence of aluminum chloride and an inert solvent to form an intermediate and hydrolyzing the intermediate in aqueous acid to give the desired product compounds of Ib. The reaction is shown in flow diagram I.

FLOW DIAGRAM I



For compounds of formula Ib the substituents R^1 , R^2 , R^3 , R^6 and n are as defined hereinabove for formula I and Ia and m is 0 or an integer of 1, 2 or 3. The oximes of formula Ib may be O-alkylated or O-acylated using conventional alkylation and acylation techniques.

The substituents of the benzophenones produced according to the processes of the invention may be derivatized further according to established methods or routine adaptations thereof, such as hydrogenation, acylation, cleavage of ether bonds, alkylation or nitration.

The formula Ia compounds of the invention are excellent fungicides, especially for the control of phytopathogenic fungi in agriculture or related fields. They are useful for the control of powdery mildew diseases, particularly of *Erysiphe graminis*, *Podosphaera leucotricha* or *Uncinula necator*. Due to excellent plant tolerance, the compounds may be used in all cultivation of plants where infection by the controllable fungi is not desired, e.g. small grain cereals, apples, vine. The absence of target crop phytotoxicity at fungus control rates is a feature of the present invention.

The present invention also provides a fungicidal composition which comprises a compound of formula I or Ia as defined hereinabove and an agriculturally acceptable carrier. Said composition may contain one or more compounds of the present invention. Preferably, at least one carrier in a composition according to the invention is a surface-active agent. For example, the composition may contain at least two carriers, at least one of which is a surface-active agent.

The compounds according to formula I or Ia may be applied as technical material, however, said compounds are preferably applied as a composition comprising, besides the formula I or Ia compounds, adjuvants and auxiliaries which are known for formulation purposes and are manufactured into e.g. emulsion concentrates, solutions which may be sprayed directly or diluted, diluted emulsions, wettable powders, soluble powders, dusts, granulates, microencapsulates by well-established procedures. The form of application such as spraying, atomizing, dispersing, pouring may be chosen like the compositions according to the desired objectives and the given circumstances.

It is contemplated, compounds of formula I or Ia may be formulated or applied, either alone or in combination, with one or more pesticides or plant growth regulants. Pesticides used in combination may be herbicides, insecticides or other fungicides or a combination thereof. When the formula I or Ia compounds are applied in combination with another pesticide or pesticides, they may be applied simultaneously or sequentially. Among the available fungicides which may be used in combination with formula I compounds are 4,6-dinitro-o-cresol, benalaxyl, benomyl, captafol, captan, carbendazim, chlorothalonil, copper, cymoxanil, dichlofluanid, dichlorone, difenoconazole, dimethomorph, diniconazole, dinocap, dithianon, fenpiclonil, fenpropimorph, hymexazol, imazalil, iprodione, isoprothiolane, kasugamycin, mancozeb, mepronil, mercuric oxide, oxadixyl, oxolinic acid, penconazole, propineb, pyrifenoxy, thiabendazole, thiram, tolclofos-

methyl, triadimefon, triflumizole, triforine validamycin A, vinclozolin, zineb, ziram, and the like.

The fungicidal compositions of the invention may be prepared by well-established procedures, e.g. intensive mixing and/or grinding of the active ingredients with other substances, such as fillers, solvents, solid carriers, and optionally surface-active compounds (tensides).

Solvents may be aromatic hydrocarbons, preferably the fractions C_8 to C_{12} , e.g. xylenes or xylene mixtures, substituted naphthalenes, phthalic acid esters, such as dibutyl or dioctyl phthalate, aliphatic hydrocarbons, e.g. cyclohexane or paraffins, alcohols and glycols as well as their ethers and esters, e.g. ethanol, ethyleneglycol mono- and dimethyl ether, ketones such as cyclohexanone, strongly polar solvents such as N-methyl 2-pyrrolidone, dimethyl sulphoxide, alkyl formamides, epoxidized vegetable oils, e.g. epoxidized coconut or soybean oil, water.

Solid carriers, which may be used for dusts or dispersible powders, may be mineral fillers, such as calcite, talc, kaolin, montmorillonite, attapulgite. The physical properties may be improved by addition of highly dispersed silica gel or highly dispersed polymers.

Carriers for granulates may be porous material, e.g. pumice, broken brick, sepiolite, bentonite, non-sorptive carriers may be calcite or sand. Additionally, a multitude of pre-granulated inorganic or organic materials may be used, such as dolomite or crushed plant residues.

Suitable surface-active substances may be non-ionogenic, anionic or cationic tensides with good dispersing, emulating and wetting properties depending on the nature of the benzophenone compound to be formulated. Tensides may also mean mixtures of tensides.

Suitable tensides may be so-called water-soluble soaps as well as water-soluble synthetic surface-active compounds. Soaps usually are alkali, earth alkali or optionally substituted ammonium salts of higher fatty acids (C_{10} - C_{20}), e.g. the sodium or potassium salts of oleic or stearic acid or of mixtures of natural fatty acids which are prepared, for example, from coconut or tallow oil. Furthermore, methyl-aurine salts of fatty acids may be used. However, so-called synthetic tensides are preferably used, especially fatty sulphonates, fatty sulphates, sulphonated benzimidazole derivatives or alkyl aryl sulphonates. The fatty sulphates or fatty sulphonates are normally used as alkali, earth alkali or optionally substituted ammonium salts and have an alkyl moiety of 8 to 22 carbon atoms, whereby alkyl also means the alkyl moiety of acyl residues, such as the sodium or calcium salt of lignin sulphonic acid, of sulphuric acid dodecylate or of a mixture of fatty alcohols prepared from natural fatty acids. This also includes the salts of sulphuric acid esters, sulphonic acids and adducts of fatty alcohols and ethylene oxide. The sulphonated benzimidazole derivatives preferably contain 2 sulphonic acid residues and a fatty acid residue with 8 to 22 carbon atoms. Alkyl aryl sulphonates are, for example, the sodium, calcium or triethyl ammonium salts of dodecyl benzene sulphonic acid, dibutyl naphthalene sulphonic acid or of a condensate of naphthalene sulphonic acid and formaldehyde. Furthermore, phosphates, such as the salts of the phosphoric acid ester of a nonylphenol-(4-14)-ethylene oxide adduct or phospholipids, may be used.

Non-ionic tensides are preferably polyglycoether derivatives of aliphatic or cycloaliphatic alcohols, saturated or non-saturated fatty acids and alkylphenols, which have 3 to 10 glycol ether groups and 8 to 20 carbon atoms in the (aliphatic) hydrocarbon residue and 6 to 18 carbon atoms in the alkyl residue of the alkyl phenols. Other suitable non-ionic tensides are the water-soluble, 20 to 250 ethylene glycol ether groups containing polyadducts of ethylene oxide and polypropylene glycol, ethylene diamino polypropylene glycol and alkyl polypropylene glycol with 1 to 10 carbon atoms in the alkyl moiety, the substances normally contain 1 to 5 ethylene glycol units per propylene glycol unit. Examples of non-ionic tensides are nonylphenol polyethoxy ethanols, castor oil polyglycol ether, polyadducts of ethylene oxide and polypropylene, tributyl phenoxy polyethoxy ethanol, polyethylene glycol, octyl phenoxy polyethoxy ethanol. Furthermore, fatty acid esters of polyoxy ethylene sorbitan, such as polyoxy ethylene sorbitan trioleate may be used.

Cationic tensides preferably are quaternary ammonium salts, which have at least one alkyl residue with 8 to 22 carbon atoms and, furthermore, low, optionally-halogenated alkyl, benzyl or hydroxyalkyl residues. The salts are preferably halides, methyl sulphates or alkyl sulphates, e.g. stearyl trimethyl ammonium chloride or benzyl bis(2chloroethyl) ethyl ammonium bromide.

The tensides generally used for compositions of the invention are disclosed in publications such as:

"McCutcheon's Detergents and Emulsifiers Annual", MC Publishing Corp., Ridgewood, NJ, USA 1981;

H. Stache, "Tensid-Taschenbuch", 2nd ed., C. Hanser, Munich, Vienna, 1981;

M. and J. Ash, "Encyclopedia of Surfactants", vol. I-III, Chemical Publishing Co., New York, NY, USA 1980-1981.

The pesticidal compositions of the invention may comprise 0.1% to 95%, preferably 0.1% to 80% of at least one compound of formula I or Ia, 1% to 99.9% of a solid or liquid adjuvant and 0% to 25%, preferably 0.1% to 25%, of a tenside.

Exemplary of the compositions of the invention are:

Emulsion Concentrates:

Active ingredient: 1% to 20%, preferably 5% to 10% Surface-active substance: 5% to 30%, preferably 10% to

20% Liquid carrier: 50% to 94%, preferably 70% to 85%

Suspension-Concentrates:

Active ingredient: 5% to 75%, preferably 10% to 50% Water: 94% to 24%, preferably 88% to 30% Surface-active substance: 1% to 40%, preferably 2% to 30%

Wettable Powder:

Active ingredient: 0.5% to 90%, preferably 1% to 80% Surface-active substance: 0.5% to 20%, preferably 1% to 15% Solid carrier: 5% to 95%, preferably 15% to 90%

Dusts:

Active ingredient: 0.1% to 10%, preferably 0.1% to 1% Solid carrier: 99.9% to 90%, preferably 99.9% to 99%

Granulates:

Active ingredient: 0.5% to 30%, preferably 3% to 15% Solid carrier: 99.5% to 70%, preferably 97% to 85%

As commodity the inventive fungicidal compositions may preferably be in a concentrated form whereas the end-user generally employs diluted compositions. Said compositions may be diluted to a concentration of 0.001% of active ingredient (a.i.). The doses usually are in the range from 0.01 to 10 kg a.i./ha.

Said compositions may also comprise other auxiliaries such as stabilizers, defoamer, viscosity controlling agents, thickeners, adhesives, fertilisers or other active ingredients to obtain special effects.

For a more clear understanding of the invention, the following specific examples are set forth below. These examples are merely illustrations and are not to be understood as limiting the scope and underlying principles of the invention in any way. Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art from the following examples and foregoing description. Such modifications are also intended to fall within the scope of the appended claims. The terms HNMR, CIMS and IR as used in the examples hereinbelow designate proton nuclear magnetic resonance, mass spectrum and infrared, respectively.

Example 1

2,6-Dichloro-4',5'-dimethoxy-2'-methylbenzophenone (Compound 1)

(R¹=Cl, R²=6-Cl, R³=CH₃, R⁴=CH₃, R⁵=OCH₃, X=O, Y=O, m=1, n=0)

A mixture of 4-methyl-veratrol (76.1 g; 500 mmol), 2,6-dichlorobenzoyl chloride (120.4 g; 575 mmol) and iron(III) chloride (0.5 g) is heated with stirring. The reaction starts at 90 °C under formation of hydrogen chloride, the main reaction is complete within 10 min at 95 °C. Subsequently, the reaction mixture is stirred for another 30 min at 100 °C and then cooled to 65 °C. Upon addition of methanol (350 ml) Compound 1 begins to crystallize. A water/methanol mixture (1:1 v/v; 300 ml) is then slowly added at 40 °C and the mixture is cooled to room temperature with stirring for 30 min. The solid material is collected by vacuum filtration, three times washed with methanol/water (3:1 v/v; 100 ml each) and dried yielding colorless crystals, 148.6 g, (91.4% y) mp 101.5°C.

Example 2

Derivatization of benzophenones

A) 2,6-Dichloro-4',5'-dimethoxy-2'-nitro-benzophenone (Compound 2)

(R¹=Cl, R²=6-Cl, R³=NO₂, R⁴=CH₃, R⁵=OCH₃, X=O, Y=O, m=1, n=0)

A portion of 2,6-dichloro-3',4'-dimethoxybenzophenone (6.22 g, 20 mmol), prepared analogously to Example 1, is added within 15 min into nitric acid (65%; 40 ml) which is heated to 40 °C. The clear solution is stirred for 10 min at 40 °C, then 1 h at room temperature. The reaction mixture is then poured into water whereupon a slowly solidifying oil forms. This material is dissolved in a small amount of N,N-dimethyl formamide under warming, then methanol is added and the mixture is chilled and filtered giving Compound 2 as yellow crystals, 5.57 g, (78% y) with mp 143°C.

B) 2'-Amino-2,6-dichloro-4',5'-dimethoxybenzophenone (Compound 3)(R¹=Cl, R²=6-Cl, R³=N₄, R⁴=CH₃, R⁵=OCH₃, X=O, Y=O, m=1, n=0)

A portion of 2,6-dichloro-3',4'-dimethoxy-2'-nitrobenzophenone (Compound 2; 3.56 g, 10 mmol) is added to a mixture of water (50 ml), glacial acetic acid (1 ml) and powdered iron (3.30 g, 60 mmol) within 15 min at 70 °C. The reaction mixture is stirred at 95 °C for another 3 h. After cooling, toluene (50 ml) is added and the solid material removed by vacuum filtration. The filter cake is washed with toluene. The filtrate and washings are combined and washed with water, dried and then applied onto a flash chromatography column (silica gel, 50 g). The column is consecutively eluted with toluene, and toluene containing 1%, 2%, 5% and 10% of acetone (250 ml each). The fraction eluted by 10% acetone is concentrated in vacuo to a final volume of 10 ml whereby Compound 3 crystallizes yielding yellow crystals, 1.61 g, (49% y) mp 181 °C.

C) 2,6-Dichloro-4',5'-dimethoxy-2'-formylamino-benzophenone (Compound 4)(R¹=Cl, R²=6-Cl, R³=NHCHO, R⁴=CH₃, R⁵=OCH₃, X=O, Y=O, m=1, n=0)

A mixture of 2'-amino-2,6-dichloro-4',5'-dimethoxybenzophenone (Compound 3; 0.82 g, 2.5 mmol) and formic acid (30 ml) is heated at reflux temperature for 24 h, and evaporated in vacuo. The residue is dissolved in a small amount of toluene, Compound 4 crystallizes upon addition of cyclohexane giving colorless crystals, 0.64 g, (72% y) with mp 152°C.

D) 2,6-Dichloro-5'-hydroxy-4'-methoxy-2'-methylbenzophenone (Compound 5)(R¹=Cl, R²=6-Cl, R³=CH₃, R⁴=CH₃, R⁵=OH, X=O, Y=O, m=1, n=0)

A mixture of 2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone (Compound 1; 2.5 g, 7.7 mmol), hydrogen bromide/acetic acid (33%, 10 ml) and glacial acetic acid (10 ml) is stirred for 1.5 h at 75°C, poured into water (100 ml) and twice extracted with dichloromethane (50 ml each). The extracts are combined, dried, and concentrated in vacuo. The resulting oil is applied onto the top of a flash chromatography column (silica gel, 30 g). Elution is carried out with toluene and toluene/acetone, 9:1 (500 ml each). The fractions containing the material with an R_f = 0.54 (silica gel; toluene/acetone, 9:1) are combined and the solvent is evaporated in vacuo until a final volume of 20 ml is reached. The solution is then extracted three times with aqueous sodium hydroxide (2 N; 30 ml each). The aqueous layer is acidified with hydrochloric acid (6 M) and the precipitate is collected by vacuum filtration and dried to give Compound 5 as colorless crystals, 1.1 g, (45.9% y) mp 152 °C.

E) 2,6-Dichloro-4'-methoxy-2'-methyl-5*n*-propoxy-benzophenone (Compound 6)(R¹=Cl, R²=6-Cl, R³=CH₃, R⁴=CH₃, R⁵=O-*n*-C₃H₇, X=O, Y=O, m=1, n=0)

A mixture of 2,6-dichloro-5'-hydroxy-4'-methoxy-2'-methylbenzophenone (Compound 5; 1.0 g, 3.2 mmol), *n*-propyl bromide (0.5 g, 4 mmol), potassium carbonate (2.8 g, 20 mmol) and ethanol (10 ml) is stirred for 6 h at 80°C, filtered and the filtrate is evaporated in vacuo. The residue is applied onto a flash chromatography column (silica gel, 30 g). Elution with toluene (750 ml) yields Compound 6 as a brown oil, 800 mg, (70.7% y) which slowly crystallizes (mp 73-75°C).

F) 2,6-Dichloro-4',5'-dimethoxy-2'-methyl-benzothione (Compound 7)(R¹=Cl, R²=6-Cl, R³=CH₃, R⁴=O-CH₃, R⁵=O-CH₃, X=S, Y=O, m=1, n=0)

A mixture of 2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone (Compound 1; 3.25 g, 10.0 mmol), phosphorus pentasulphide (2.22 g, 10.0 mmol) and toluene (50 ml) is stirred at 110°C for 5 h, treated with *p*-dioxane, stirred at 100°C for a further 24 h. The supernatant is decanted from black, tarry reaction products, silica gel (15 g) is added and the solvent is evaporated in vacuo. A flash chromatography column is packed with silica gel (100 g) and the charged silica gel is layered on top of it. The column is subsequently eluted with petrol ether/acetone (500 ml, 98:2, v/v) and petrol ether/acetone (750 ml, 95:5, v/v) yielding Compound 7 as a dark green oil 40 mg, (1.2% y), which slowly solidifies. When the oil is triturated with cyclohexane three times, it gives a solid, mp 142°C

Example 3

Using essentially the same procedures described hereinabove for Examples 1 and 2 and employing standard derivatization techniques where appropriate, the following compounds are prepared and shown in Table I.

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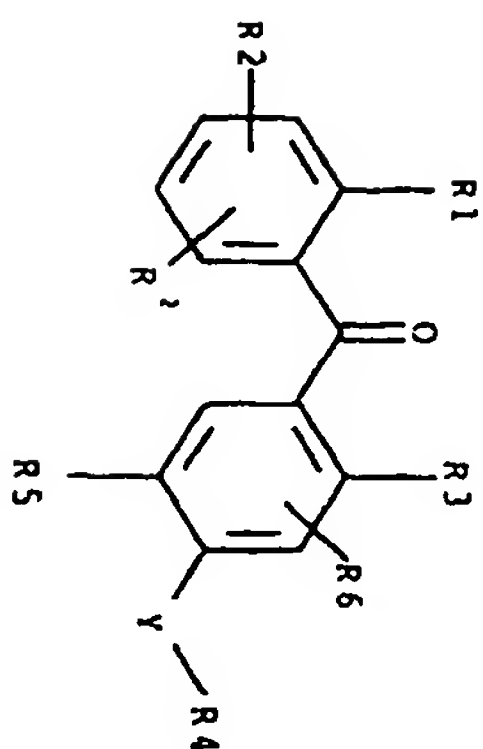


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	MP °C	
8	Cl	6-Cl	H	CH ₃	CH ₃	OC ₂ H ₅	H	O	87
9	Cl	6-Cl	H	CH ₃	C ₂ H ₅	OCH ₃	H	O	106
10	Cl	6-Cl	H	CH ₃	CH ₃	Cl	H	O	168
11	Cl	6-Cl	3-NO ₂	CH ₃	CH ₃	OCH ₃	H	O	oil
12	Br	H	H	CH ₃	CH ₃	OCH ₃	H	O	69-71
13	Cl	6-Cl	H	CH ₃	CH ₃	OC(O)C ₂ H ₅	H	O	142-145
14	Cl	6-Cl	H	CH ₃	CH ₃	H	H	O	89
15	I	H	H	CH ₃	CH ₃	OCH ₃	H	O	66-68
16	Cl	6-CH ₃	H	CH ₃	CH ₃	OCH ₃	H	O	56
17	Cl	6-CH ₃	H	F	CH ₃	OCH ₃	H	O	95
18	(CH=CH),		6-Cl	CH ₃	CH ₃	OCH ₃	H	O	
19	I	3-I	5-I	CH ₃	CH ₃	OCH ₃	H	O	oil
20	Br	5-Br	H	CH ₃	CH ₃	OCH ₃	H	O	oil
21	Cl	4-NO ₂	H	CH ₃	CH ₃	OCH ₃	H	O	126-128

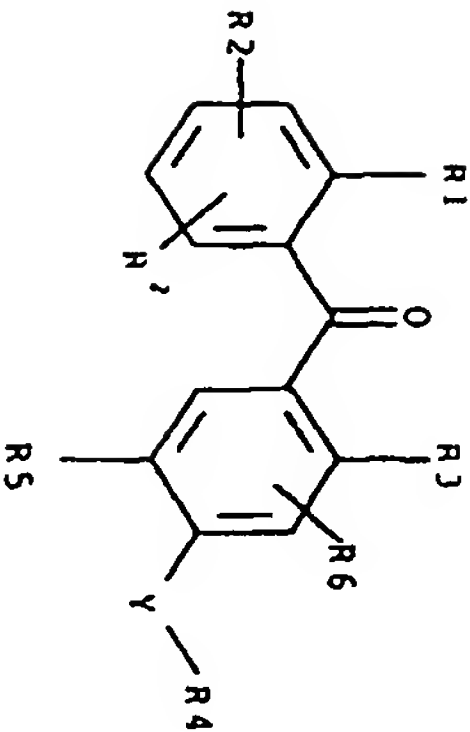


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C
22	Cl	6-Cl	H	CH ₃	SCH ₃	H	S	105
23	Cl	6-Cl	H	CH ₃	OCH ₃	2-OCH ₃	O	92
24	Cl	6-Cl	H	CH ₃	CH ₂ O	H	O	142
25	Cl	6-Cl	H	CH ₃	I	H	S	
26	Br	5-OCH ₃	H	CH ₃	OCH ₃	H	O	oil
27	Cl	5-Br	H	CH ₃	OCH ₃	H	O	94-96
28	Cl	6-Cl	H	CH ₃	OC(O)CH- (CH ₃) ₂	H	O	132-135
29	Cl	5-Cl	6-OCH ₃	CH ₃	OCH ₃	H	O	oil
30	Cl	6-Cl	H	CF ₃	Cl	H	O	
31	Cl	6-Cl	H	CH ₃	OCHF ₂	H	O	126-128
32	CF ₃	5-CF ₃	H	CH ₃	OCH ₃	H	O	98-101
33	Cl	6-Cl	H	CH ₃	H	3-OCH ₃	O	100-125

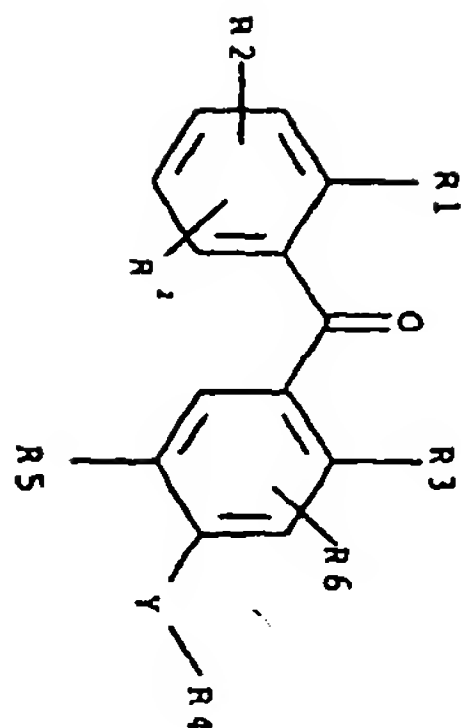


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C
34	Cl	6-Cl	H	CH ₃	CH ₃	OC(O)C- (CH ₃) ₃	H	O 167
35	Cl	6-Cl	H	CH ₃	H	OH	H	O 201-203
36	Cl	6-Cl	H	SCH ₃	CH ₃	OCH ₃	H	O 185
37	Cl	6-Cl	H	S(O ₂)CH ₃	CH ₃	OCH ₃	H	O 163
38	Cl	6-Cl	H	CH ₃	CH ₃	CH ₃	3-CH ₃	O 78
39	Cl	6-Cl	H	S(O)CH ₃	CH ₃	OCH ₃	H	O 178
40	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ CH=CH 2	H	O oil
41	Cl	3-Cl	5-Cl	CH ₃	CH ₃	OCH ₃	H	O 99-101
42	Cl	6-Cl	H	CH ₃	(CH ₂) ₂ O		H	O oil
43	Cl	6-Cl	H	CH ₃	CHF ₂	OCHF ₂	H	O 65-68
44	CF ₃	6-CF ₃	H	CH ₃	CH ₃	OCH ₃	H	O 105-107
45	Cl	6-Cl	H	CH=CH ₂	CH ₃	OCH ₃	H	O

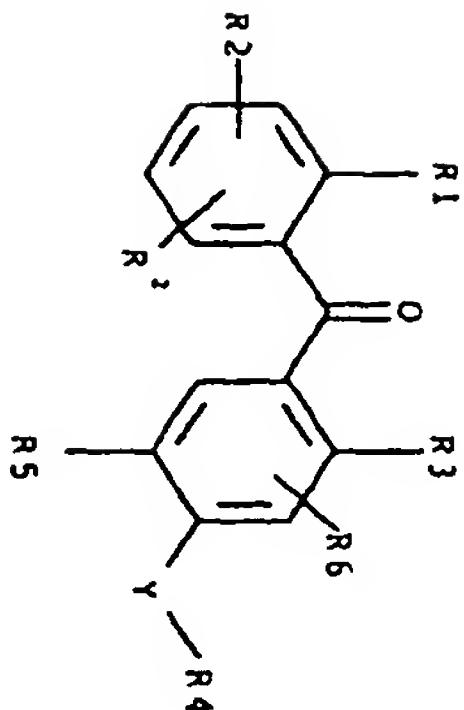


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	mp °C
46	I	6-F	H	CH ₃	CH ₃	OCH ₃	H	oil
47	Cl	3-Cl	H	CH ₃	CH ₃	OC ₂ H ₅	H	97
48	Cl	6-Cl	H	CH ₃	C ₂ H ₅	OC ₂ H ₅	H	77
49	Cl	6-Cl	H	CH=CH-CN	CH ₃	OCH ₃	H	
50	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	3-Br	86
51	Cl	4-Cl	5-Cl	CH ₃	CH ₃	OCH ₃	H	160
52	Cl	6-Cl	H	CH ₃	CH ₃	C ₄ H ₉ -L	H	124
53	Cl	6-Cl	H	CH ₃	CH ₃	OC ₄ H ₉ -D	H	51
54	Cl	6-Cl	H	CH ₃	CH ₃	OC ₄ H ₉ -L	H	oil
55	Cl	6-Cl	H	CH ₃	CH ₃	H	H	S
56	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ C ₆ H ₅	H	119-121
57	Cl	6-Cl	H	CH ₃	CH ₃	OC ₅ H ₁₁ -D	H	46-48
58	Cl	6-Cl	H	CH ₃	CH ₃	OC ₃ H ₇ -L	H	oil
59	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	2-OH	161

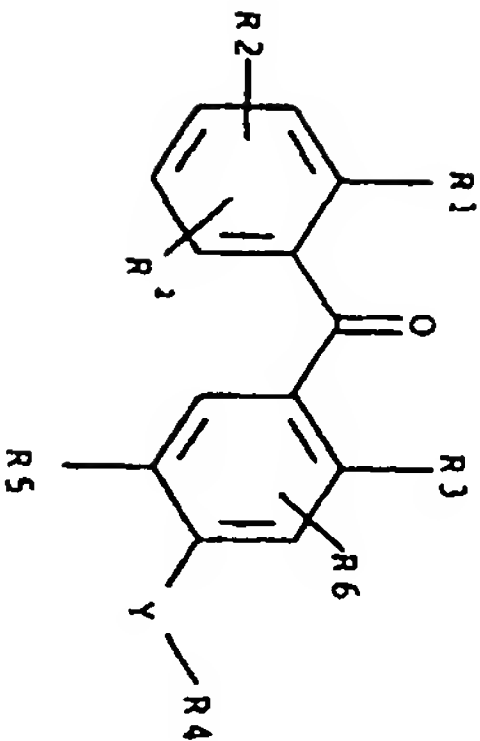


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C
60	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ C(O)- OC ₂ H ₅	H	105-108
61	Cl	6-Cl	H	CH ₃	CH ₃	H	2-OCH ₃	135
62	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	2-OC ₂ H ₅	72
63	Cl	6-Cl	H	CH ₃	CH ₃	Cl	H	
64	Cl	4-Cl	6-Cl	CH ₃	CH ₃	OCH ₃	H	108-109
65	Cl	6-Cl	H	CH ₃	CH ₃	Br	H	
66	F	6-F	H	CH ₃	CH ₃	OCH ₃	H	75-77
67	Cl	H	H	CH ₃	CH ₃	OCH ₃	H	oil
68	Cl	4-Cl	H	CH ₃	CH ₃	OCH ₃	H	oil
69	Cl	6-Cl	H	CH ₃	CH ₃	CH ₃	H	135-138
70	Cl	6-Cl	H	CF ₃	CH ₃	Br	H	
71	Cl	5-Cl	H	CH ₃	CH ₃	OCH ₃	H	100-102
72	Cl	6-Cl	H	C ₂ H ₅	CH ₃	OCH ₃	H	oil

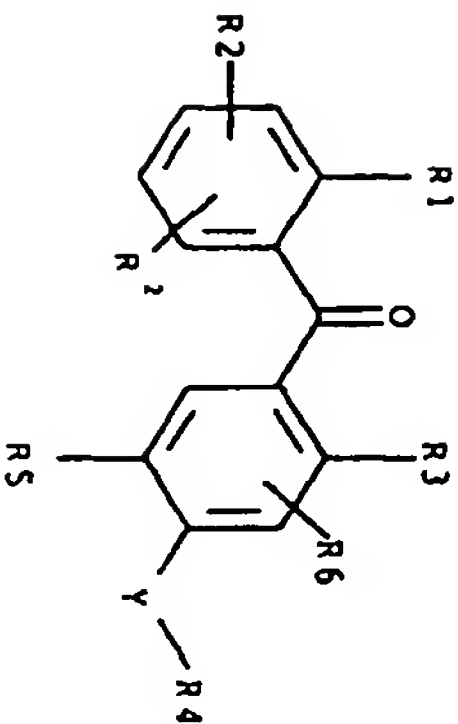


Table I

Comp No.	R ¹	R ²	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	MP °C
73	Cl	3-Cl	H	CH ₃	CH ₃	OCH ₃	H	O	oil
74	Cl	6-Cl	H	CN	CH ₃	OCH ₃	H	O	120
75	F	6-CF ₃	H	CH ₃	CH ₃	OCH ₃	H	O	oil
76	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ CN	H	O	127
77	Cl	6-F	H	CH ₃	CH ₃	OCH ₃	H	O	72-73
78	Cl	6-Cl	H	I	CH ₃	OCH ₃	H	O	101
79	Cl	6-Cl	H	C ₃ H ₇ -D	CH ₃	OCH ₃	H	O	72
80	Cl	6-Cl	H	CH ₃	CH ₃	OC(O)CH ₃	H	O	156-159
81	Cl	6-Cl	H	Br	CH ₃	OCH ₃	H	O	124
82	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ C≡CH	H	O	87
83	Cl	6-Cl	H	H	CH ₃	H	3-OCH ₃	O	127
84	Cl	6-Cl	H	CH ₃	H	H	3,6-di- CH ₃	O	122

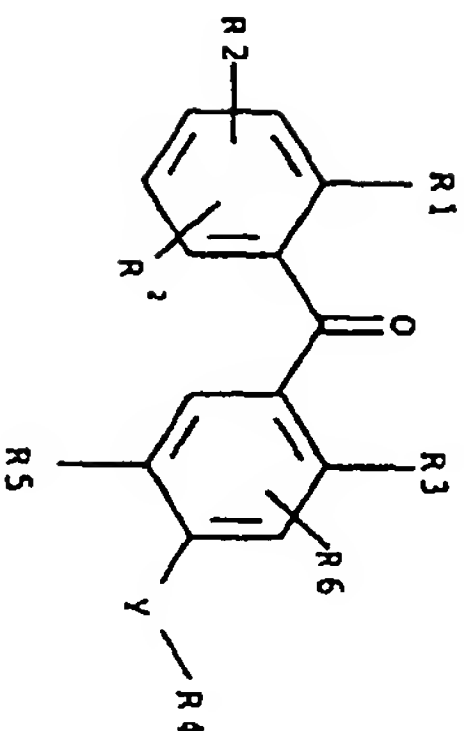


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C
85	Cl	6-Cl	H	CH ₃	CH ₃	3,6-di- CH ₃	O	111
86	Cl	6-Cl	H	CF ₃	C(O)- 2,6- Cl ₂ C ₆ H ₃	H	O	186
87	CH ₃	6-CH ₃	H	H	CH ₃	3-OCH ₃	O	84
88	Cl	6-Cl	H	H	CH ₃	3-Br	O	129
89	Cl	6-Cl	H	H	CH ₃	Br	O	140
90	Cl	6-Cl	H	OCH ₃	CH ₃	OCH ₃	O	124
91	Cl	6-Cl	H	CH ₃	CH ₃	OC(O)H	O	156
92	OCH ₃	6-OCH ₃	H	CH ₃	CH ₃	OCH ₃	O	113
93	Cl	6-Cl	H	COOH	CH ₃	OCH ₃	O	174
94	Cl	6-Cl	H	CH ₃	CH ₃	S(O) ₂ CH ₃	SO ₂	233
95	Cl	6-Cl	H	CH ₃	CH ₃	SOCH ₃	SO	227
96	Cl	6-Cl	H	CH ₃	CH ₃	O ₆ -C ₇ H ₁₅	O	oil

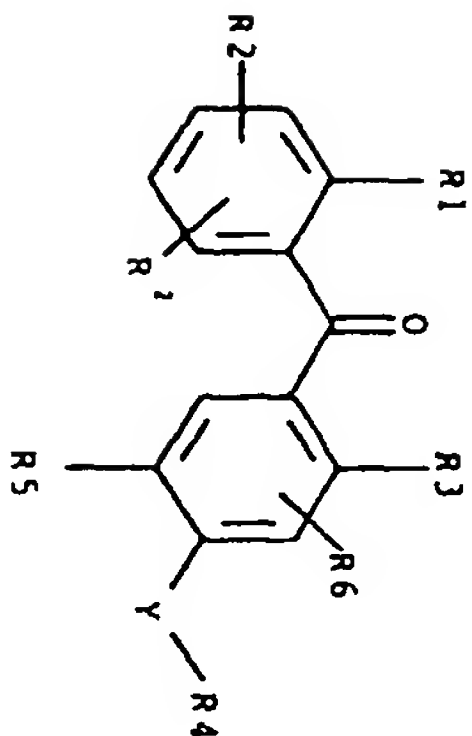


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C	
97	Cl	6-Cl	H	CH ₃	CH ₃	O ₆ .C ₈ H ₁₇	H	O	oil
98	Cl	6-Cl	H	CH ₃	CH ₃	O ₆ .C ₁₀ H ₂₁	H	O	oil
99	CH ₃	4-CH ₃	6-CH ₃	CH ₃	CH ₃	OCH ₃	H	O	74
100	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ -c- C ₃ H ₅	H	O	oil
101	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ -c- C ₆ H ₁₁	H	O	108
102	Cl	6-Cl	H	CH ₃	CH ₃	O(CH ₂) ₂ - CH(CH ₃) ₂	H	O	oil
103	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ CH=C -(CH ₃) ₂	H	O	oil
104	CH ₃	6-CH ₃	H	CH ₃	CH ₃	OCH ₃	H	O	90-92
105	Cl	6-Cl	H	CH ₃	CH ₃	Oc-C ₅ H ₉	H	O	oil
106	Cl	6-Cl	H	CH ₃	CH ₃	Oc-C ₆ H ₁₁	H	O	oil

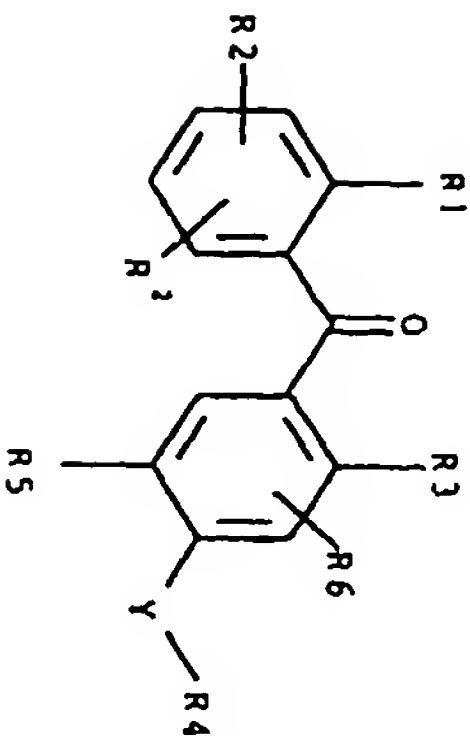


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C	
107	Cl	6-Cl	H	H	CH ₃	(3)-(CH=CH-) ₂ -(2)	H	O	155- 157
108	Cl	6-Cl	H	CH ₃	CH ₃	ONa	H	O	glass
109	Cl	6-Cl	H	CH ₃	CH ₃	OSi(CH ₃) 3	H	O	oil
110	Br	6-Br	H	CH ₃	CH ₃	OCH ₃	H	O	102
111	Cl	6-Cl	H	CH ₃	CH ₃	OK	H	O	98
112	Cl	6-Cl	H	OCH ₃	CH ₃	Br	2-OCH ₃	O	183
113	CN	H	H	CH ₃	CH ₃	OCH ₃	H	O	76
114	Cl	6-Cl	H	CH ₃	-CH ₂ O-	2-OCH ₃			98
115	Cl	6-Cl	H	NH-CH ₃	CH ₃	OCH ₃	H		163
116	Cl	6-Cl	H	OH	CH ₃	OCH ₃	H	O	80
117	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ - Si(CH ₃) ₃	H	O	oil
118	Cl	H	H	CH ₃	CH ₃	OCH ₃	H	O	62-64

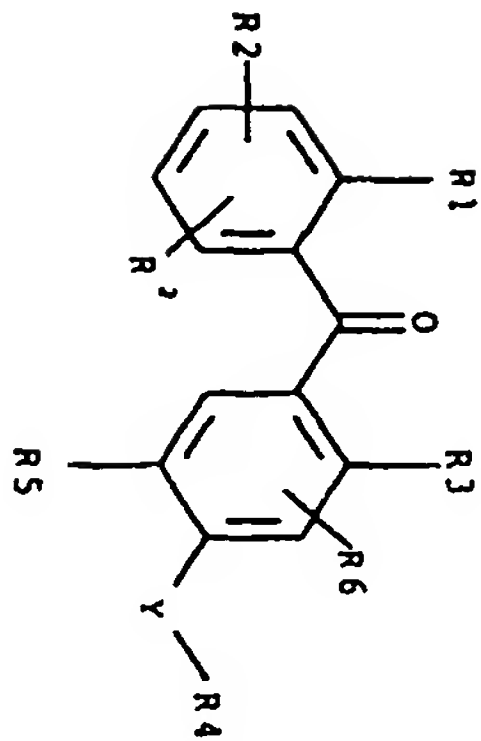


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	MP °C
119	Cl	3-Cl	H	CH ₃	OCH ₃	2-OCH ₃	O	oil
120	Cl	4-Cl	6-Cl	CH ₃	OCH ₃	H	O	126
121	F	6-F	H	CH ₃	OCH ₃	H	O	84
122	Cl	5-Cl	H	CH ₃	OCH ₃	H	O	oil
123	Cl	6-Cl	H	OCH ₃	CH ₃	6-OCH ₃	O	115
124	I	H	H	CH ₃	OCH ₃	2-OCH ₃	O	oil
125	Br	H	H	CH ₃	OCH ₃	H	O	34
126	Cl	6-Cl	H	CH ₃	Op-C ₆ H ₁₃	H	O	oil
127	Cl	6-Cl	H	CH ₃	OCH ₃	2Op-C ₃ H ₇	O	46
128	Cl	6-Cl	H	CH ₃	OCH ₃	2Op-C ₇ H ₁₅	O	oil
129	Cl	6-Cl	H	CH ₃	OCH ₃	2Op- C ₁₀ H ₂₁	O	oil
130	Cl	6-Cl	H	CH ₃	OCH ₃	2-OC(O)- CH ₃	O	164

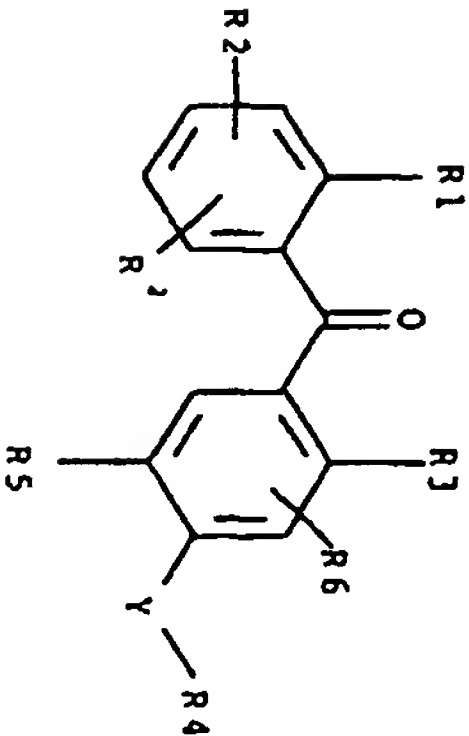


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C
131	Cl	6-Cl	H	CH ₃	CH ₃	20n- C ₅ H ₁₁	O	oil
132	Cl	6-Cl	H	CH ₃	CH ₃	20(CH ₂) ₂ -CH- (CH ₃) ₂	O	101
133	Cl	6-Cl	H	CH ₃	CH ₃	20CH ₂ - CH=CH ₂	O	73
134	Cl	6-Cl	H	CH ₃	CH ₃	20CH ₂ C≡CH	O	123
135	Cl	6-Cl	H	CH ₃	CH ₃	20c-C ₅ H ₉	O	89
136	Cl	6-Cl	H	CH ₃	CH ₃	60CH ₂ - C ₆ H ₅	O	80
137	Cl	6-Cl	H	CH ₃	CH ₃	20n- C ₁₂ H ₂₅	O	oil
138	Cl	6-Cl	H	CH ₃	CH ₃	20CH ₂ - c-C ₆ H ₁₁	O	88

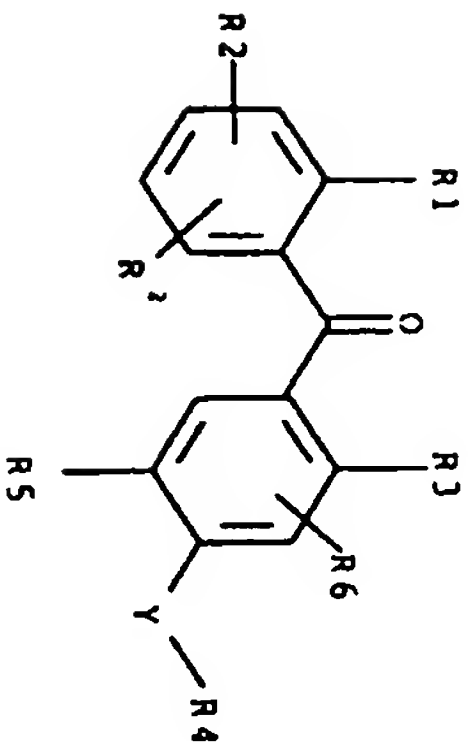


Table I

Comp No.	R ¹	R ²	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	mp °C
139	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	20α- C ₆ H ₁₃	O	oil
140	Cl	6-Cl	H	CH ₃	CH ₃	On-C ₁₂ H ₂₅	H	O	oil
141	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ C(O)N -(C ₂ H ₅) ₂	H	O	97
142	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ C(O)N -H ₂	H	O	136
143	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	20(CH ₂) ₂ -OCH ₃	O	84
144	Cl	6-Cl	H	CH ₃	CH ₃	OCH- (C ₂ H ₅) ₂	H	O	oil
145	Cl	6-Cl	H	CH ₃	CH ₃	O(CH ₂) ₂ - OH	H	O	87
146	Cl	6-Cl	H	CH ₃	CH ₃	O(CH ₂) ₃ - OH	H	O	86

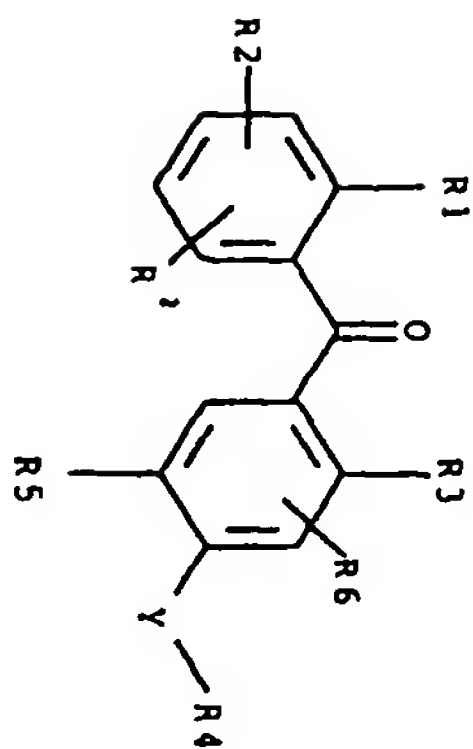


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C	
147	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ -p- C ₆ H ₄ -CH ₃	H	O	oil
148	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ -p- C ₆ H ₄ - C(CH ₃) ₃	H	O	119
149	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	2OCH ₂ C(O)	O	oil
morpholid e									
150	Cl	6-Cl	H	CH ₃	CH ₃	O(CH ₂) ₂ OC H ₃	H	O	oil
151	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ - C(O)- morpholid e	H	O	163

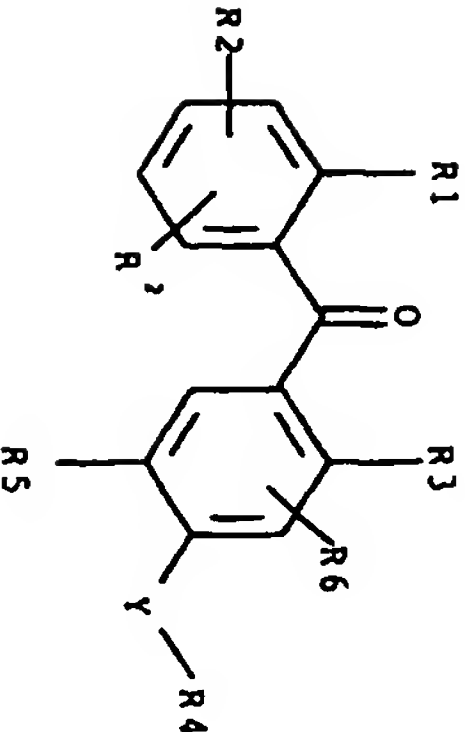


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C	
152	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ -p- C ₆ H ₄ -OCH ₃	H	O	oil
153	Cl	6-Cl	H	CH ₃	CH ₃	O(CH ₂) ₃ OC 6H ₅	H	O	oil
154	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	20(CH ₂) ₃	O	225
155	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	20(CH ₂) ₂ -N(CH ₃) ₂ × HCl	O	103
156	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	20(CH ₂) ₂	O	144
157	Cl	6-Cl	H	CH ₃	CH ₃	OC ₂ H ₅	2-OCH ₃ N(C ₂ H ₅) ₂ × HCl	O	68

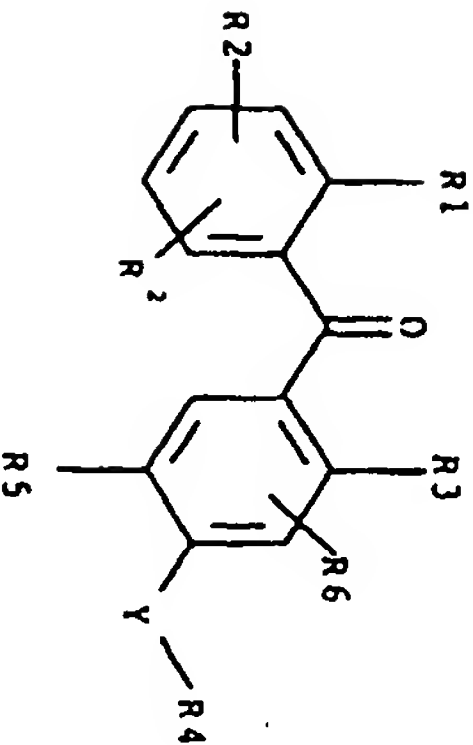


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C
158	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	20(CH ₂) ₃ Cl	87
159	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	20(CH ₂) ₃	70
160	Cl	6-Cl	H	CH ₃	n-C ₇ H ₁₅	OCH ₃	H	51
161	Cl	6-Cl	H	CH ₃	n-C ₃ H ₇	OCH ₃	H	80
162	Cl	6-Cl	H	CH ₃	n-C ₄ H ₉	OCH ₃	H	89
163	Cl	6-Cl	H	CH ₃	CH ₃	CH(CH ₃) ₂	H	96
164	CH ₃	3-CH ₃	H	CH ₃	CH ₃	OCH ₃	6-OCH ₃	82
165	CH ₃	5-CH ₃	H	CH ₃	CH ₃	OCH ₃	6-OCH ₃	oil
166	Cl	6-Cl	H	Cl	CH ₃	OCH ₃	H	114
167	Cl	6-Cl	H	CH ₃	CH ₃	O(CH ₂) ₁₁ CO ₂ C ₂ H ₅	H	oil

piperidy
1x HCl

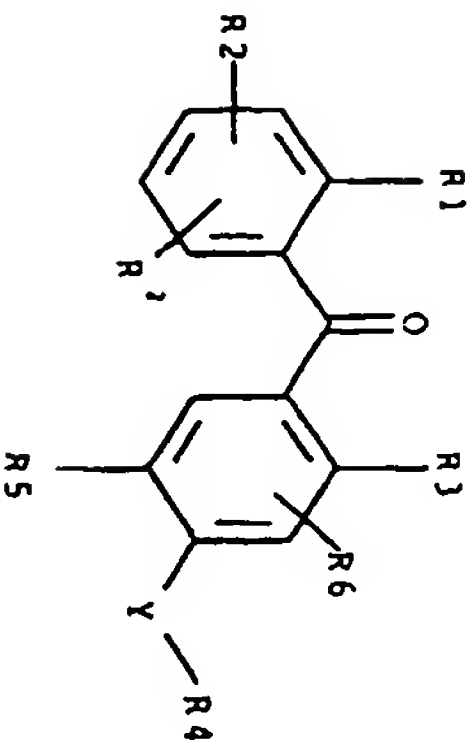


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C	
168	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ C ₆ H ₄ - CF ₃ -p	H	O	115-117
169	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ SiC ₂ H ₅ (CH ₃) ₂	H	O	85
170	Cl	6-Cl	H	CH ₃	CH ₃	OC(CH ₃) ₂	H	O	102
171	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₂ CH ₂ OCH ₃ , CH ₃ OCH	H	O	oil
172	Cl	6-Cl	H	CH ₃	CH ₃	O(CH ₂) ₄ Br	H	O	oil
173	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	6-O(CH ₂) ₃ N- (C ₂ H ₅) ₂	O	oil
174	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	6-OCH- (CH ₃) ₂	O	108
175	Cl	6-Cl	H	CH ₃	CH ₃	OCH ₃	6-OCH ₂ CH ₂ - OCH ₂ CH ₂ OCH ₃	O	oil

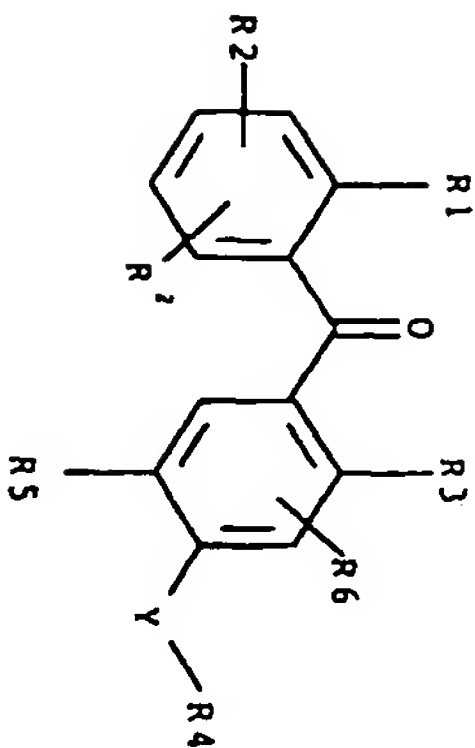


Table I

Comp No.	R ¹	R ²	R ³	R ⁴	R ⁵	R ⁶	Y	Mp °C
176	Cl	6-Cl	H	CH ₃	CH ₃	OCOC ₂ H ₅ Cl, -2,6	6-OCH ₃	0 186-189
177	Cl	6-Cl	H	H	CH ₃	OCH ₃	6-OCH ₃	0 97
178	Cl	6-Cl	H	CH ₃	CH ₃	CH ₃	6-OCH ₃	0 106
179	Cl	6-Cl	H	OCH ₃	CH ₃	OCH ₃	6-OCH ₃	0 121-123
180	Cl	6-Cl	H	CH ₃	CH ₃	NHCOCH ₃	H	0 155
181	Cl	6-Cl	H	CH ₃	CH ₃	OH	6-OH	0 182
182	CF ₃	H	H	CH ₃	CH ₃	OCH ₃	6-OCH ₃	0 oil
183	CF ₃	H	H	CH ₃	CH ₃	OCH ₃	H	0 oil
184	Cl	6-Cl	H	CH ₃	CH ₃	OC ₂ H ₅ -n	6-OC ₂ H ₅ -n	0 oil
185	Cl	6-Cl	H	CH(CH ₃) ₂	CH ₃	CH ₃	H	0 110
186	Cl	6-Cl	H	CH ₃	H	NO ₂	H	0 170
195	O-CF ₃ -O		H	CH ₃	CH ₃	OCH ₃	H	0

Example 42'-n-Butoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone (Compound 187)

5 (R¹=Cl, R²=6-Cl, R³=CH₃, R⁴=CH₃, R⁵=OCH₃, R⁶=2-O-(CH₂)₃-CH₃, X=O, Y=O, m=1, n=1)

a) 2,6-Dichloro-3',4'-dimethoxy-2'-hydroxy-6'-methylbenzophenone Compound 59)

10 Aluminum chloride (14.67 g, 0.1 mol), 2,6-dichlorobenzoyl chloride (20.95 g, 0.1 mol) and a solution of 3,4,5-trimethoxytoluene (18.22 g, 0.1 mol) in dichloromethane (50 ml), are slowly and consecutively added to dichloromethane stirred at 0°C, stirred for 1 h at ice bath temperatures and for 16 h at room temperature, and poured into ice. The organic layer is separated, washed with dilute hydrochloric acid and water, dried, and, after addition of silica gel (100 g), concentrated in vacuo. A flash chromatography column is packed with silica gel (400 g) and the charged silica gel is layered on top of that. Elution with petrol ether/ethyl acetate (90/10, 1 l; 80/20, 1 l; 50/50, 1 l) yields 2,6-dichloro-3',4'-dimethoxy-2'-hydroxy-6'-methylbenzophenone, 10.35 g, (30% y), mp. 161°C.

b) 2,6-Dichloro-3',4'-dimethoxy-2'-hydroxy-6'-methylbenzophenone, potassium salt (Compound 188)

20 (R¹=Cl, R²=6-Cl, R³=CH₃, R⁴=CH₃, R⁵=OCH₃, R⁶=2-OK, X=O, Y=O, m=1, n=1)

A solution of 2,6-dichloro-3',4'-dimethoxy-2'-hydroxy-6'-methylbenzophenone (10.24 g, 30 mmol) is dissolved in ethanolic potassium hydroxide (1.98 g, 30 mmol; 85% in ethanol (100 ml)) and stirred at 70 °C for 15 min. The solvent is then evaporated in vacuo. The residue is dissolved in hot ethanol (50 ml), toluene is added and the solvent is evaporated in vacuo giving Compound 188, 11.7 g.

c) 2'-n-Butoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone (Compound 187)

30 A mixture of 2,6-dichloro-3',4'-dimethoxy-2'-hydroxy-6'-methylbenzophenone, potassium salt (1.13 g; 3 mmol), 1-bromobutane (0.69 g, 5 mmol) and dimethyl formamide (5 ml) are stirred at 100°C for 8 h, and concentrated in vacuo. The residue is dissolved by shaking with a toluene/water mixture, after separation, the organic layer is collected washed with water and dried. After addition of silica gel (5 g), the solvent is evaporated. A flash chromatography column is packed with silica gel (25 g) and the charged silica gel is layered on top of that. Elution with petrol ether/ethyl acetate (95/5, 500 ml) gives the title compound, 0.82 g, (69% y) as colourless crystals, mp. 70°C.

Example 5

Using essentially the same procedures described in Examples 1, 2 and 4 hereinabove and employing, if required, standard derivatization methods, the following compounds shown in Table II are prepared

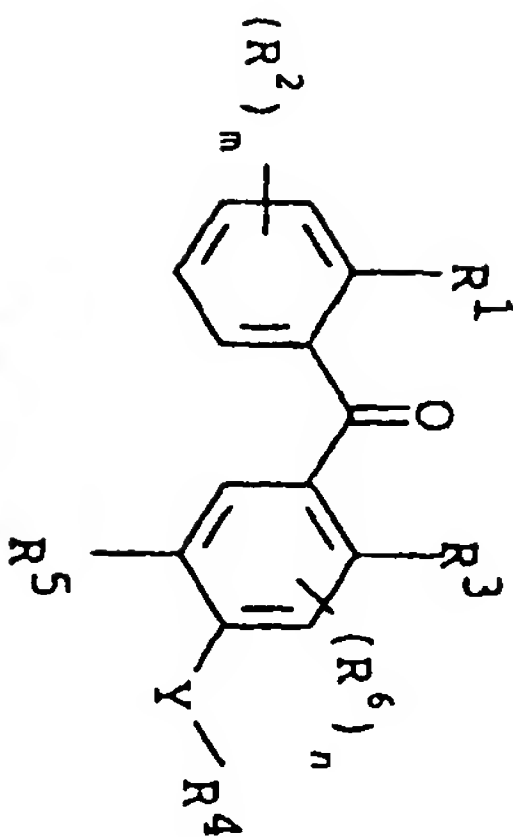


Table II

Comp. No.	R ¹	R ²	m	R ³	Y-R ⁴	R ⁵	R ⁶	n	mp °C
189	CH ₃	3,5,6-CH ₃	3	CH ₃	OCH ₃	OCH ₃	H	0	103
190	CH ₃	CH ₃	4	CH ₃	OCH ₃	OCH ₃	H	0	142-144.5
191	CH ₃	3,5,6-CH ₃	3	CH ₃	OCH ₃	OCH ₃	6-OCH ₃	1	113
192	CH ₃	3,5,6-CH ₃	3	CH ₃	OCH ₃	OCH ₂ CH ₂ CH(CH ₃) ₂	H	0	73
193	CH ₃	3,5,6-CH ₃	3	CH ₃	OCH ₃	OCH ₂ CH ₂ CH ₃	H	0	85
194	CH ₃	3,5,6-CH ₃	3	CH ₃	OCH ₃	OCH ₃	6-OH	1	137

Example 6

2,6-Dichloro-3',4'-dimethoxybenzophenone oxime (Compound 195) $R^1=Cl$; $R^2=6-Cl$, $R^3=H$; $Y=O$; $R^4=CH_3$; $R^5=H$; $R^6=4-OCH_3$; $R=H$

A stirred dispersion of anhydrous aluminum chloride (2.93 g, 22 mmol) in methylene chloride at ice-bath temperatures is treated sequentially with a solution of 2,6-dichlorobenzonitrile oxide (3.76 g, 20 mmol) in methylene chloride and, dropwise, with a solution of veratrole (3.32 g, 24 mmol) in methylene chloride, stirred for 0.5 hour, allowed to warm to room temperature, stirred for 4-5 hours and poured into a mixture of ice and HCl. The resultant phase mixture is separated. The organic phase is washed with 2 M HCl, treated with silica gel and evaporated to dryness *in vacuo*. The residue is placed on top of a column of silica gel and eluted with mixtures of petroleum ether and ethyl acetate (5%, 10% and 20% pet ether, respectively) to give the title product as a white solid, 1.25 g (19% y) mp 153°C.

Example 7

2,6-Dichloro-4',5'-dimethoxy-2'-methylbenzophenone n-propyloxime (Compound 196)

$R^1=Cl$; $R^2=6-Cl$; $R^3=CH_3$; $Y=O$; $R^4=CH_3$; $R^5=OCH_3$; $R^6=H$; $R=CH_2CH_2CH_3$

A stirred solution of 2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone oxime (1.5 g, 4.4 mmol) in anhydrous tetrahydrofuran is treated with a 60% dispersion of sodium hydride in mineral oil (0.2 g, 4.8 mmol NaH). After the cessation of hydrogen gas evolution, the reaction mixture is treated with n-propyl iodide (0.82 g, 5.3 mmol), allowed to stand at room temperature for 12 hours, and diluted with water. The resultant phase mixture is extracted with ethyl acetate. The organic phases are combined and concentrated *in vacuo* to give a residue. The residue is chromatographed using silica gel and petroleum ether/ethyl acetate, 8/2, to give the title product as a yellow oil, 0.4 g (23.8% y) identified by NMR (67:23, E/Z isomer ratio).

Example 8

2,6-Dichloro-4',5'-dimethoxy-2'-methylbenzophenone-O-acetyloxime (Compound 197)

$R^1=Cl$; $R^2=6-Cl$; $R^3=CH_3$; $Y=O$; $R^4=CH_3$; $R^5=OCH_3$; $R^6=H$; $R=COCH_3$

A stirred solution of 2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone oxime (2.3 g, 6.8 mmol) in anhydrous tetrahydrofuran is treated with a 60% dispersion of sodium hydride in mineral oil (0.3 g, 7.5 mmol NaH). After the cessation of hydrogen gas evolution, the reaction mixture is treated with acetyl chloride (0.55 g, 7.5 mmol) at room temperature, allowed to exotherm to 30°C, stirred at ambient temperatures for 2 hours, concentrated *in vacuo*, treated with water, and filtered. The filtercake is washed with water, dried and recrystallized from methanol to give the title product as white crystals, 1.0 g (38.5% y), mp 158-149°C, identified by NMR (100% E isomer).

Example 9

Using essentially the same procedures described for Examples 6-8 hereinabove the following compounds are obtained and shown in Table III.

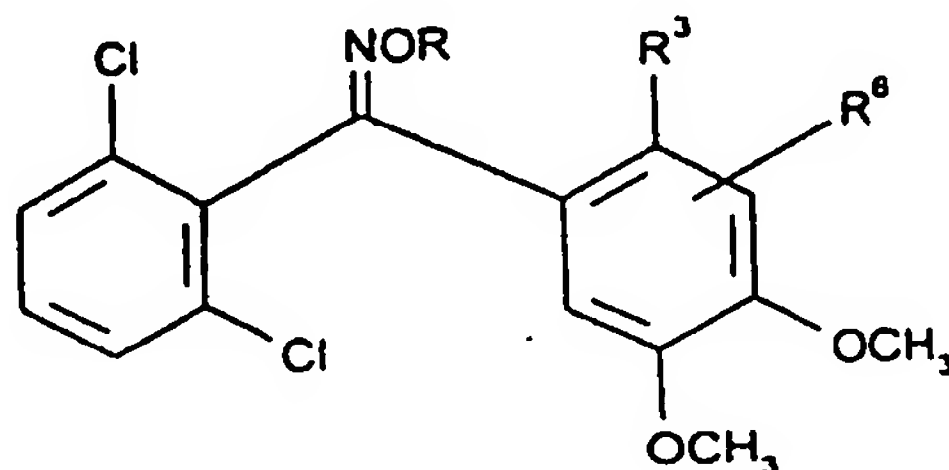


Table III

Compound No.	R	R3	R6	mp °C
198	H	F	H	oil
199	H	H	H	153
200	H	CH ₃	H	60-70
201	H	CH ₃	6-OCH ₃	219-220
202	CH ₃	CH ₃	H	112-115
203	CH(CH ₃) ₂	CH ₃	H	117
204	CH ₂ CH ₂ CH ₂ CH ₃	CH ₃	H	oil

Example 102,6-Dichloro-2',3',4'-trimethoxy-6'-methyl-benzophenone

A mixture of 3,4,5-trimethoxytoluene (9.11 g; 50 mmol), octane (25 ml) and iron(III)chloride (50 mg) is stirred at 105°C, and percolating nitrogene 2,6-dichlorobenzoylchloride (12.04g; 57.5 mmol) is added dropwise within 15 minutes. The mixture is kept at 105°C and stirred for another 15 minutes. After cooling to 50°C ethylacetate (50 ml) is added, the mixture shaken twice with 2 N hydrochloric acid, once with water and dried. The ethylacetate is evaporated (70°C) and the liquid cooled with stirring. At 50°C petrolether (50 ml) is added. The white crystals formed are sucked off, washed with petrolether and dried. Yield 12.55 g (70.7 %), mp. 92°C.

Example 112,6-Dichloro-2',3'-dihydroxy-4'-methoxy-6'-methylbenzophenone

A mixture of 2,6-dichloro-2',3',4'-trimethoxy-6'-methylbenzophenone (1.78 g; 5 mmol) hydrobromic acid (7.5 ml; 30 % in acetic acid) and acetic acid (7.5 ml) is stirred at 75°C for 2 hours. Water is added and the mixture extracted with methylenechloride. The extract is washed with water and shaken with 2 N sodium hydroxide. The alkaline solution is acidified with hydrochloric acid, the separated compound dissolved in methylenechloride and the solution washed with water. After evaporation of the solvent purification is carried out by chromatography (flash column, filled with 36 g of silicagel; elution with 500 ml of petrolether/ethylacetate (4:1; v/v) and 250 ml of petrolether/ethylacetate (1:1; v/v)). the fraction containing the compound is concentrated, the compound crystallized. The yellow crystals are washed with petrolether and sucked off; 0.64 g (39 % y), mp. 182°C.

Example 122',3'-Di-n-butoxy-2,6-dichloro-4'-methoxy-6'-methyl benzophenone

Sodiumhydride (0.4 g; 60 %; 10 mmol) is added with stirring to a solution of 2,6-dichloro-2',3'-dihydroxy-4'-methoxy-6'-methyl-benzophenone (1.64 g; 5 mmol) in tetrahydrofurane. The solvent is evaporated and the residue dissolved in 30 ml of dimethylformamide. 1-iodo-n-butane (4.6 g; 25 mmol) is added, the mixture is stirred at 100°C for 8 hours and then the solvent is evaporated. The residue is shaken with toluene/2 N hydrochloric acid, the organic layer separated, washed with water and the solvent evaporated. The residue is purified by chromatography (flash column filled with 35 g of silicagel; elution with 500 ml of petrolether containing 2 % of ethylacetate); yellow oil (0.7 g; 32 % y).

Example 137-(2,6-Dichlorobenzoyl)-10-methoxy-8-methyl-2,3,4,5-tetrahydro-1,6-benzodioxocin

(R⁵ + R⁶ = -O-(CH₂)₄-O-)

A mixture of 2,6-dichlorobenzoyl-2',3'-dihydroxy-4'methoxy-6'-methyl-benzophenone (3.27 g; 10 mmol), potassium carbonate (4 g), copper(II)oxide (50 mg), 1,4-dibromobutane (2.38 g; 11 mmol) and dimethylformamide (25 ml) is stirred at room temperature for 15 hours. Water is added and extracted twice with ethylacetate. The ethylacetate phase is washed with water, the solvent evaporated. The residue is purified by chromatography (flash column filled with silicagel,

elution with petrolether/ethylacetate (8:2; v/v)). From the enriched fractions the product can be crystallized with methanol. White crystals (0.56 g; 14.7 % y); mp. 103-104°C.

Example 14

2,6-Dichloro-3',4'-dimethoxy-6'-methyl-2'-phenylacetoxybenzophenone

2,6-Dichloro-3',4'-dimethoxy-2'-dihydroxy-6'-methylbenzophenone (3.41 g; 10 mmol) are added to a solution of potassium hydroxide (0.66 g; 85 %) in methanol (30 ml). The methanol is evaporated, the residue is dissolved in dimethylformamide (30 ml), phenylacetylchloride (1.70 g; 11 mmol) is added and the mixture is stirred for 15 hours. Then water is added and the mixture is extracted three times with ethylacetate. After evaporation of the solvent methanol is added to the residue to give white crystals (1.95 g; 42.5 % y); mp. 106°C.

Example 15

2,6-Dichloro-5'-difluoromethoxy-4'-methoxy-2'-methylbenzophenone

To a solution of 2,6-dichloro-5'-hydroxy-4'-methoxy-2'-methyl-benzophenone (1.0 g; 3.2 mmol) in dimethoxyethane (7 ml) a solution of sodium hydroxide (0.6 g; 15 mmol) in water (1 ml) is added. The mixture is heated to 60°C with stirring, then a stream of chlorodifluoromethane is introduced for 20 minutes. After further stirring for 1.5 hours the solvent is evaporated. The residue is extracted with a mixture of trichloromethane and water. The organic phase is separated, dried and the solvent is evaporated. For purification, a flash column with silicagel (30 g) is used (elution with mixtures of petrolether/ethylacetate 9:1, then 8:2, then 7:3 (v/v)). The resulting compound forms white crystals (0.6 g; 51.8 % y); mp. 126-128°C.

Example 16

2,6-Dichloro-5'-propionyloxy-4'-methoxy-2'-methylbenzophenone

A mixture of 2,6-Dichloro-5'-hydroxy-4'-methoxy-2'-methyl-benzophenone and propionic acid anhydride (5 ml) is stirred at 100°C for 5 hours. Toluene/water is added. The organic phase is dried and evaporated. The residue is purified by chromatography (flash column with silicagel (30 g), elution with toluene). The toluene is removed. After treatment with cyclohexane the residue forms white crystals; 0.5 g (42.6 % y); mp. 142-145°C.

Example 17

2,6-Dichloro-5'-tert-butoxy-4'-methoxy-2'-methylbenzophenone

A solution of 2,6-dichloro-5'-hydroxy-4'-methoxy-2'-methyl-benzophenone (3.0 g; 9.6 mmol) in 50 ml of methylenechloride is cooled down to -70°C, trifluoromethanesulfonic acid (0.3 ml) is added, then a stream of 2-methylpropene (5.5 g; 100 mmol) is introduced within 4 hours. Triethylamine (1.2 ml) is added, the temperature goes up to 20°C. The solution is shaken twice with diluted sodium hydroxide and the solvent is evaporated. The residue is purified chromatographically (flash column with 30 g of silicagel, elution with toluene/acetone 20:1 (v/v)). The residue is treated with petrolether to give 0.7 g of white crystals (20 % y); mp. 102°C.

Example 18

2,6-Dichloro-4'-methoxy-2'-methyl-5'-phenoxy-benzophenone

A mixture of 2-methoxy-4-methyl-diphenylether (2.1 g; 10 mmol), 2,6-dichlorobenzoylchloride (2.5 g; 12 mmol) and iron(III)chloride are heated to 100°C with stirring for 4 hours. After cooling down the mixture is shaken with toluene/water. The organic layer is dried and the solvent is evaporated. The residue is purified by chromatography (flash column filled with 30 g of silicagel, elution with toluene/petrolether 1:9, changing to 1:1 (v/v)). The residue after evaporation crystallises when treated with diisopropylether; white crystals (1.5 g; 39 % y); mp. 113.5°C.

Example 192,6-Dichloro-4'-methoxy-2'-methyl-benzophenone

5 A mixture of 2,6-dichlorobenzoylchloride (5.24 g; 25 mmol), 3-methylanisole (2.44 g; 20 mmol) and iron(III)chloride (20 mg) is heated to 100°C for 45 minutes with stirring. After cooling, toluene is added, the mixture is shaken with water, the organic phase is dried and the solvent is evaporated. The reaction product is purified chromatographically (flash column with 70 g of silicagel; elution with petrolether/toluene changing from 75:25 to 40:60 (v/v)). After evapo-
 10 ration the residue from the main fraction is treated with petrolether to give white crystals (1.33 g; 22.5 % y); mp. 89°C.

Example 205'-Bromo-2,6-dichloro-4'-methoxy-2'-methyl-benzophenone

15 A solution of bromine (0.25 ml in 3 ml of trichloromethane) is added dropwise to a stirred solution of 2,6-Dichloro-4'-methoxy-2'-methyl-benzophenone (1.5 g; 5 mmol in 5 ml of trichloromethane), followed by 15 minutes of stirring at 20°C. The mixture is shaken with water, sodium hydrogencarbonate solution and water. The organic phase is dried and evaporated. The residue is purified by chromatography (flash column filled with 30 g of silicagel, elution with petrolether/ethylacetate changing from 20:1 to 9:1, 8:2, 7:3 (v/v)). After evaporation, the residue crystallises when treat-
 20 ed with petrolether/toluene to give white crystals (0.45 g; 24 % y); mp. 159°C.

Example 202,6-Dichloro-5'-nitro-4'-methoxy-2'-methyl-benzophenone

25 2,6-Dichloro-4'-methoxy-2'-methyl-benzophenone (0.75 g; 2.5 mmol) is added to nitric acid (10 ml; 65%). The mixture is stirred at 80°C for 1 hour. After addition of water the reaction product crystallises and is chromatographically purified (flash column filled with 30 g of silicagel, elution with toluene). White crystals (0.35 g; 41 % y); mp. 156-160°C.

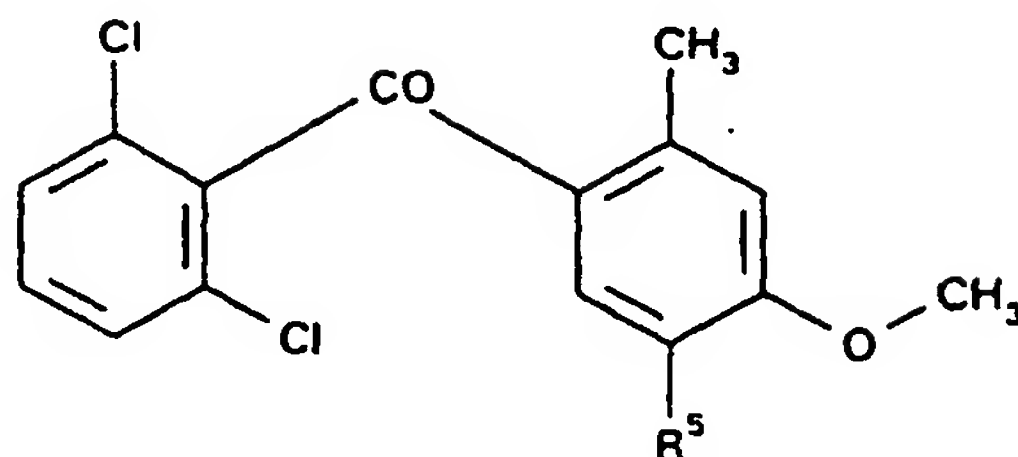
Example 212,6-Dichloro-4'-hydroxy-5'-nitro-2'-methyl-benzophenone

35 Aluminumchloride (1.5 g; 11 mmol) is added to a solution of 2,6-dichloro-5'-nitro-4'-methoxy-2'-methyl-benzophe- none (1.8 g; 5.3 mmol) in methylenechloride (6 ml). The mixture is stirred for 30 minutes at 20°C and for 1 hour at 45°C, 5 ml conc. hydrochloric acid/ice are added. After shaking with 20 ml of methylenechloride the organic layer is treated with 2 N hydrochloric acid and with water. After drying the solvent is evaporated, the residue purified by chro- matography (flash column filled with 30 g of silicagel, elution with toluene). The residue from the main fraction is treated with diisopropylether to give yellow crystals; (1.2 g; 73 % y); mp. 170°C.

40 The compounds of Tables IV to X can be prepared analogously to the examples described hereinbefore.

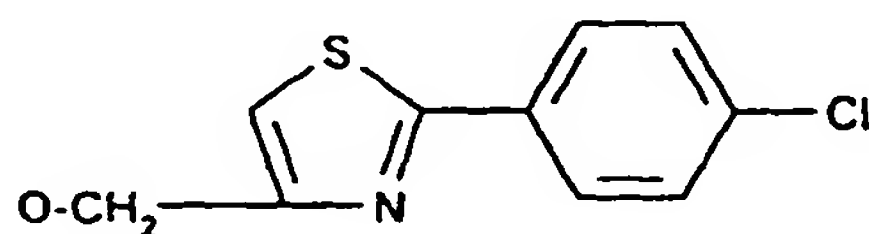
Table IV

Compounds of formula



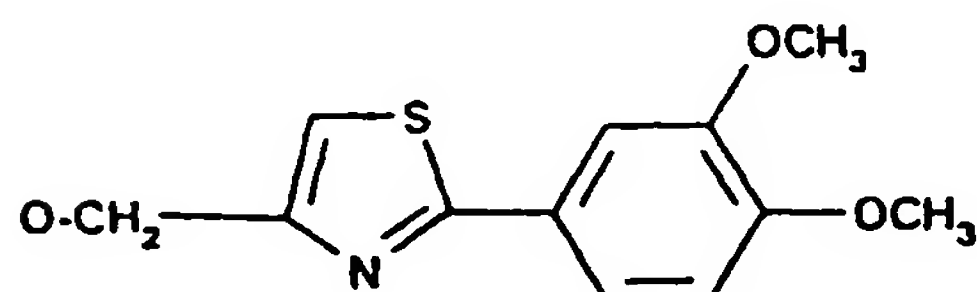
No.	R ⁵	mp. [°C]
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1	O-C ₆ H ₅	113.5
2	Br	159
3	NO ₂	156-60
4	O-CH ₂ -CONH-(4-OCH ₃ -C ₆ H ₄)	154
5	O-CH ₂ -CONH-C ₆ H ₅	133
6	O-CH ₂ -CONH-CH ₂ -C ₆ H ₅	150
7	O-CH ₂ -(2-pyridyl)	114
8	O-CH ₂ -(3-pyridyl)	119
9	O-CH ₂ -(4-pyridyl)	142



10		134
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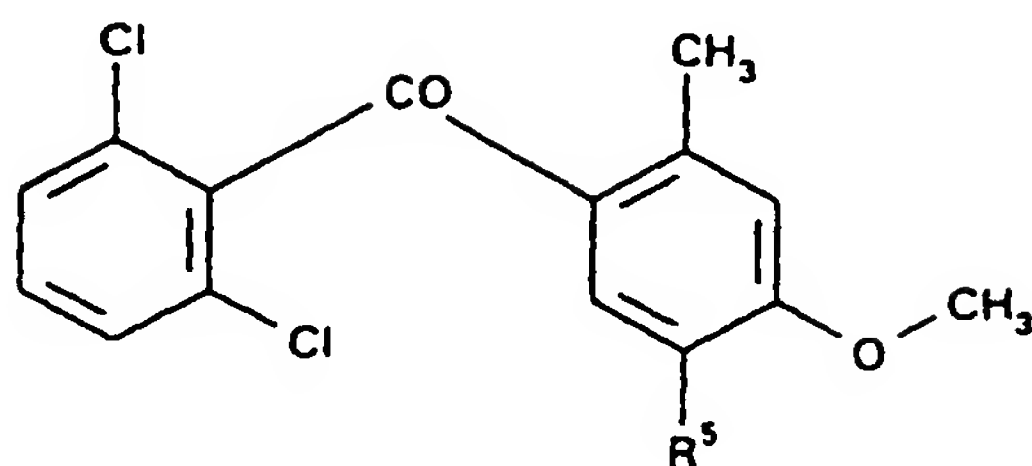
11	O-(CH ₂) ₄ -O-C ₆ H ₅	86-9
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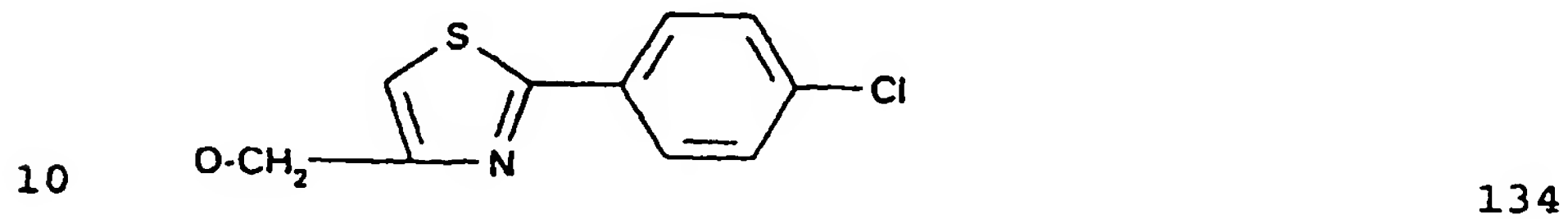
12		124
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Table IV

Compounds of formula



No.	R ⁵	mp. [°C]
1	O-C ₆ H ₅	113.5
2	Br	159
3	NO ₂	156-60
4	O-CH ₂ -CONH-(4-OCH ₃ -C ₆ H ₄)	154
5	O-CH ₂ -CONH-C ₆ H ₅	133
6	O-CH ₂ -CONH-CH ₂ -C ₆ H ₅	150
7	O-CH ₂ -(2-pyridyl)	114
8	O-CH ₂ -(3-pyridyl)	119
9	O-CH ₂ -(4-pyridyl)	142



11	O-(CH ₂) ₄ -O-C ₆ H ₅	86-9
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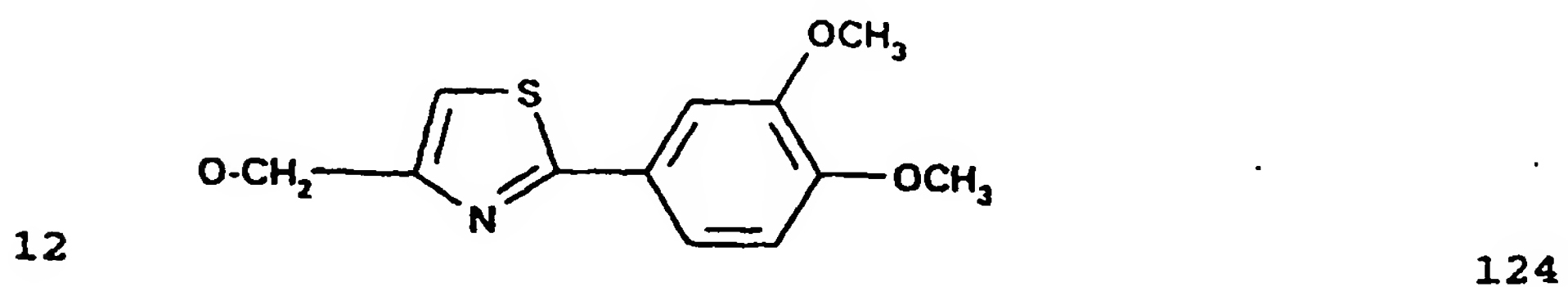


Table IV continued

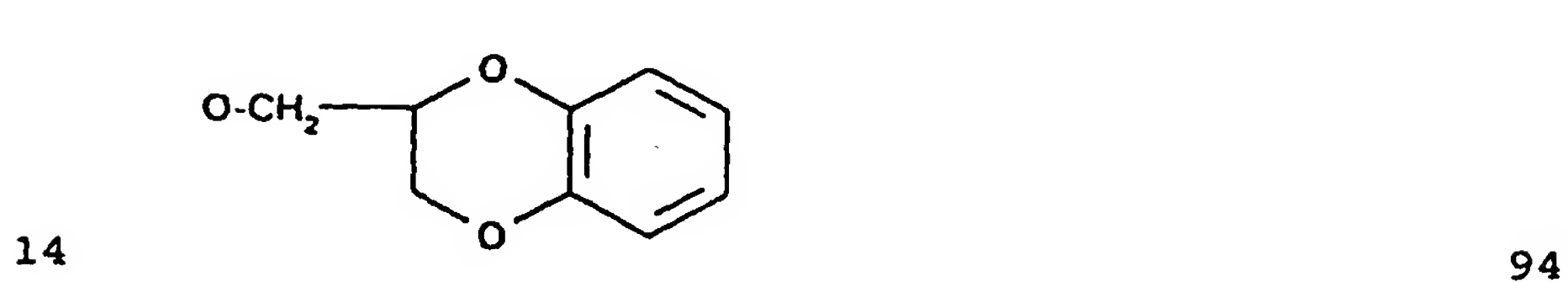
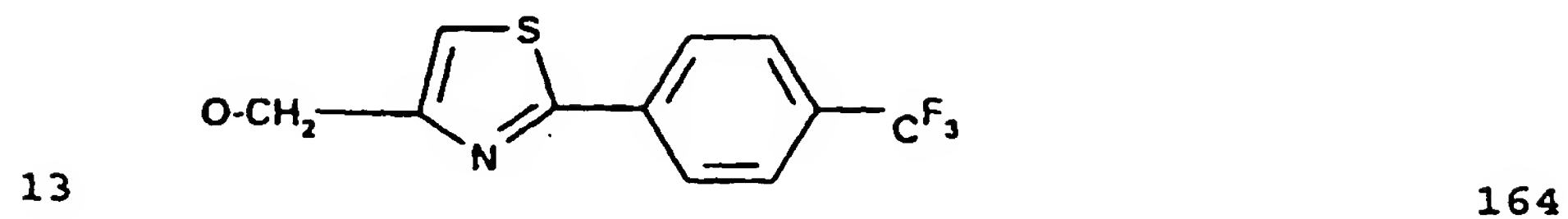
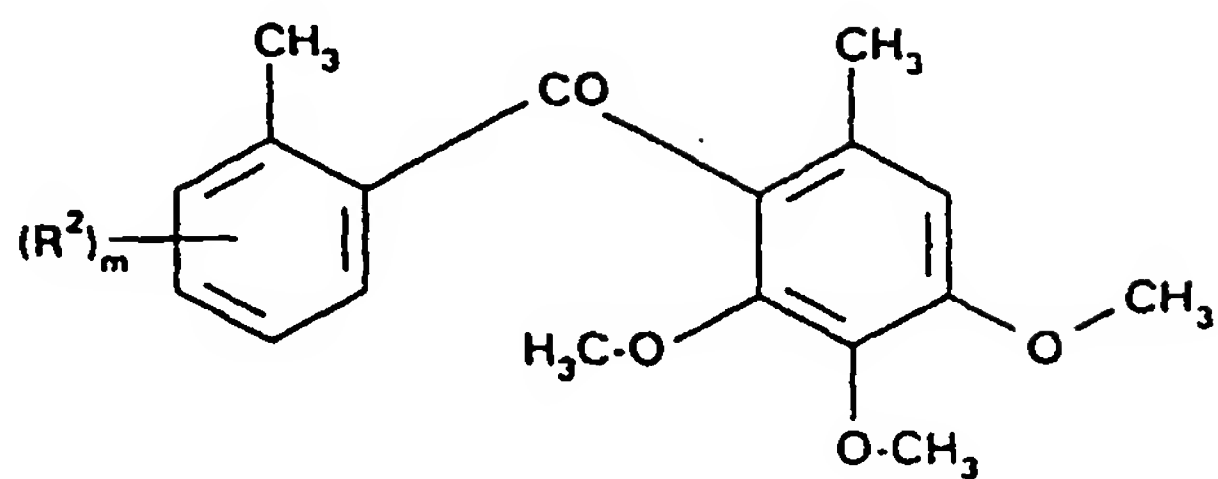


Table V

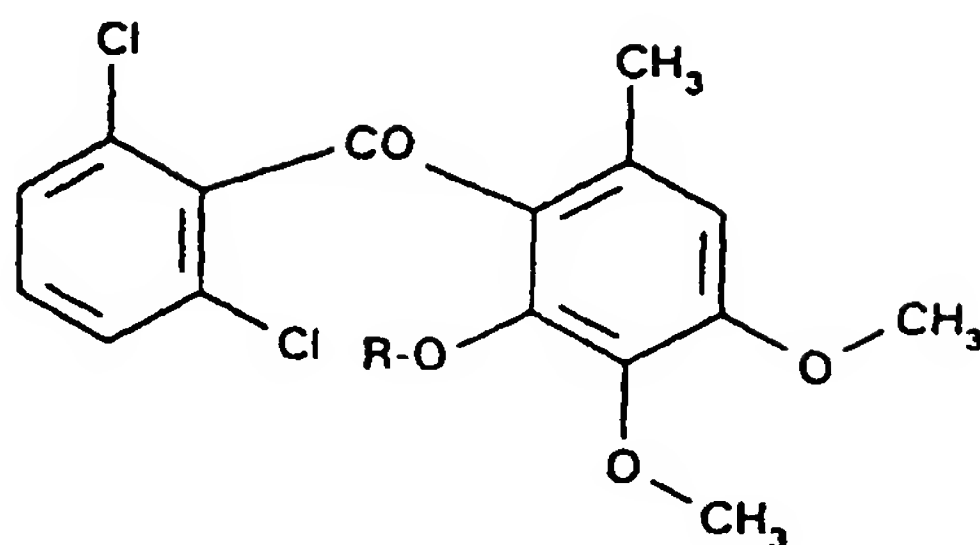
Compounds of formula



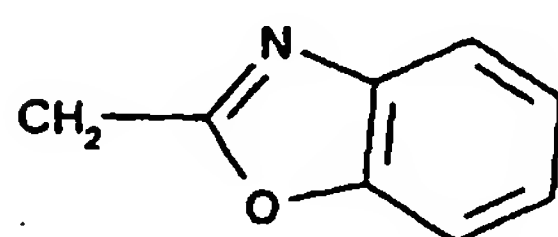
No.	(R ²) _m	mp. [°C]
1	3-CH ₃	82
2	5-CH ₃	oil
3	5-CH ₃	89
4	4,6-(CH ₃) ₂	142

Table VI

Compounds of formula



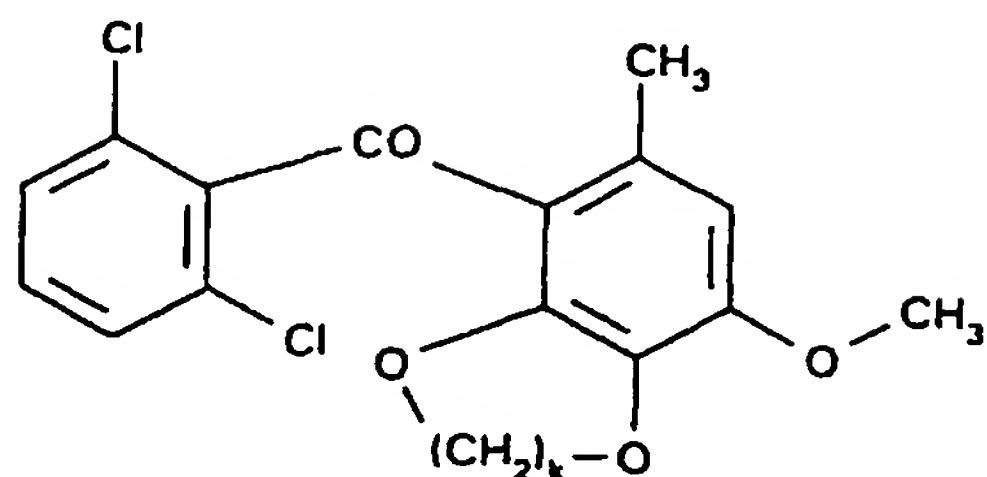
No.	R	mp. [°C]
1	CH ₂ -CH(CH ₃) ₂	105
2	CH ₂ -CH(C ₂ H ₅) ₂	65
3	CH ₂ -(2-CH ₃ -C ₆ H ₄)	73
4	CH ₂ -(3-CH ₃ -C ₆ H ₄)	88
5	CH ₂ -(4-CH ₃ -C ₆ H ₄)	92
6	CH ₂ -(4-Cl-C ₆ H ₄)	121
7	CH ₂ -(4-NO ₂ -C ₆ H ₄)	178
8	CH ₂ -(4-F ₃ CO-C ₆ H ₄)	120
9	CH ₂ -(4-CN-C ₆ H ₄)	189
10		119
11	CH ₂ -(3-CH ₃ O-C ₆ H ₄)	oil
12	CH ₂ -(4-H ₂ NCO-C ₆ H ₄)	106
13	CH ₂ -(4-CH ₃ O-C ₆ H ₄)	77
14	H	161



15	$\text{CH}_2\text{-CO-C}_6\text{H}_5$	84
No.	R	mp. [$^{\circ}\text{C}$]
5		
16	$\text{CH}_2\text{-CH=CH-C}_6\text{H}_5$	oil
17	$\text{CH}_2\text{-(4-CO}_2\text{CH}_3\text{-C}_6\text{H}_4$	106
10	18 $\text{CH}_2\text{-CH}_2\text{-CH}_2\text{-C}_6\text{H}_5$	79
19	$\text{CH}_2\text{-(2,5-(CH}_3)_2\text{-C}_6\text{H}_3)$	86
20	20 $\text{CH}_2\text{-(2,4-(CH}_3)_2\text{-C}_6\text{H}_3)$	125
15	21 $\text{CO-CH}_2\text{-C}_6\text{H}_5$	106
22	$\text{CH}_2\text{-(2-naphthyl)}$	84
23	$\text{CH}_2\text{-CH}_2\text{-CH}_2\text{-O-C}_6\text{H}_5$	79
20	24 $\text{CH}_2\text{-CH}_2\text{-C}_6\text{H}_5$	110
25	25 $\text{CH}_2\text{-CH}_2\text{-O-C}_6\text{H}_5$	oil
26	$\text{CH}_2\text{-(2-Cl-C}_6\text{H}_4)$	131
27	$\text{CH}_2\text{-(3-Cl-C}_6\text{H}_4)$	124
25	28 $\text{CH}_2\text{-(2-F-C}_6\text{H}_4)$	88
29	$\text{CH}_2\text{-(4-F-C}_6\text{H}_4)$	102
30	30 $\text{CH}_2\text{-(2-CN-C}_6\text{H}_4)$	127
31	$\text{CH}_2\text{-(3-F-C}_6\text{H}_4)$	88
32	$\text{CH}_2\text{-(3-pyridyl)}$	84
33	$\text{CH}_2\text{-(2-NO}_2\text{-C}_6\text{H}_4)$	140
35	34 $\text{CH(CH}_3\text{)-C}_6\text{H}_5$	92
35	35 $\text{CH}_2\text{-(4-CF}_3\text{-C}_6\text{H}_4)$	125

Table VII

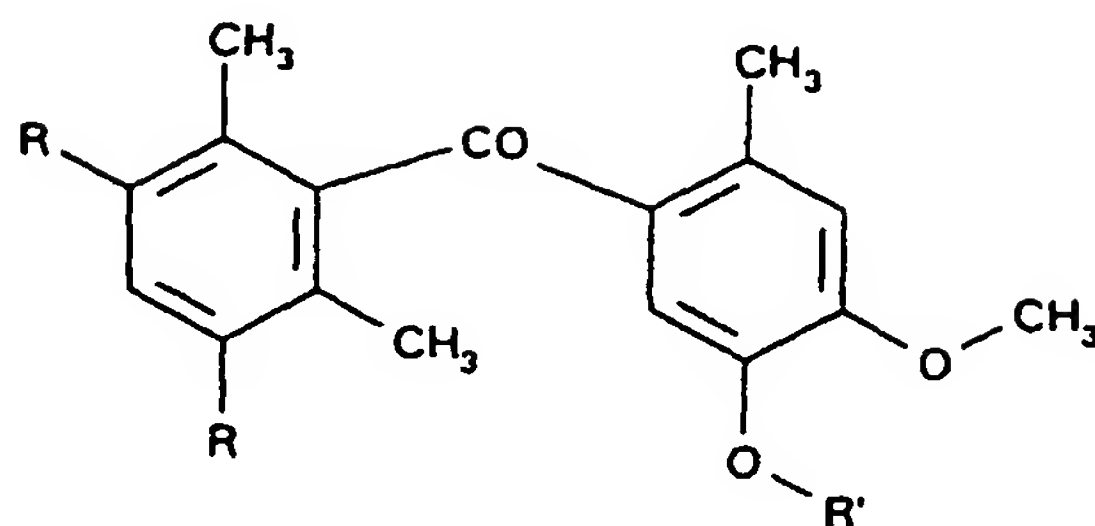
Compounds of formula



No	k	mp. [°C]
1	1	119
2	2	123-5
3	3	133
4	4	103

Table VIII

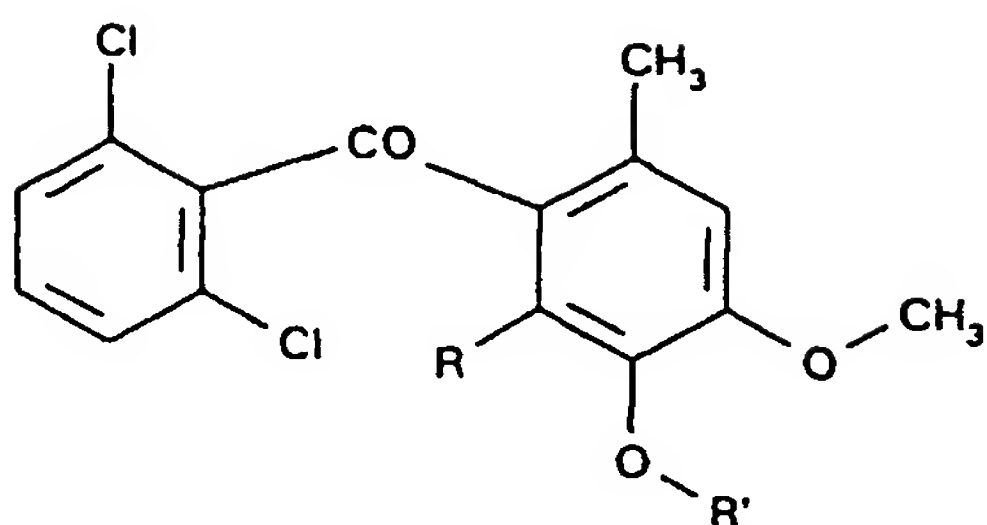
Compounds of formula



No.	R	R'	mp. [$^{\circ}\text{C}$]
1	H	n-C ₇ H ₁₅	oil
2	CH ₃	n-C ₇ H ₁₅	oil
3	H	CH ₂ -CH ₂ -CH(CH ₃) ₂	63
4	H	CH ₂ -S-C ₆ H ₅	
5	CH ₃	CH ₂ -S-t-C ₄ H ₉	

Table IX

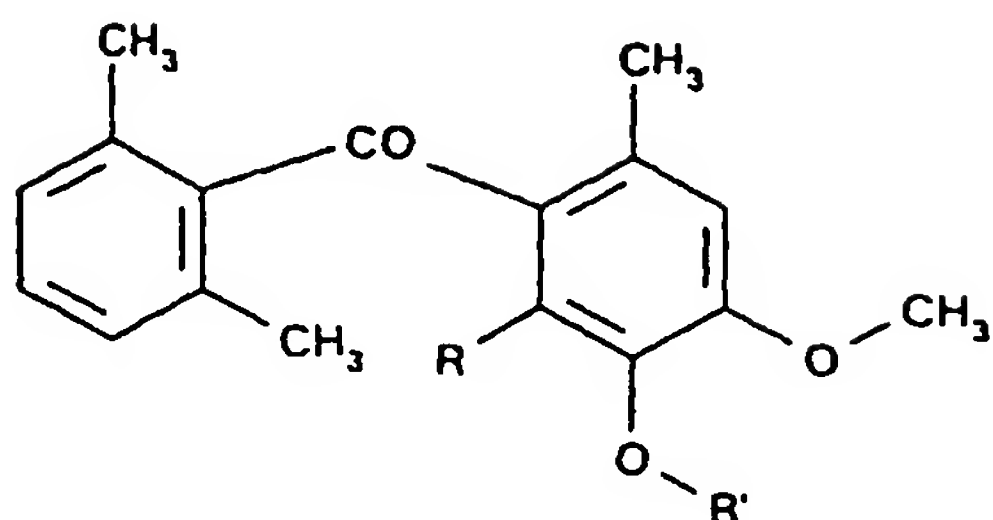
Compounds of formula



No.	R	R'	mp. [°C]
1	O-CH ₃	n-C ₅ H ₁₁	oil
2	O-CH ₂ -CH ₂ -S-C ₆ H ₅	CH ₃	
3	O-CH ₂ -CO-C(CH ₃) ₃	CH ₃	
4	H	CH ₂ -O-CH ₂ -C ₆ H ₅	
5	H	CH ₂ -S-CH ₃	
6	H	CH ₂ -SO ₂ -C ₆ H ₅	
7	H	CH ₂ -S-C ₆ H ₅	
8	CH ₃	CH ₂ -S-t-C ₄ H ₉	
9	OH	H	182
10	OH	CH ₃	
11	O-CH ₂ -O-C ₆ H ₅	CH ₃	

Table X

Compounds of formula



No.	R	R'	mp. [°C]
1	O-CH ₃	n-C ₅ H ₁₁	
2	O-CH ₂ -CH ₂ -S-C ₆ H ₅	CH ₃	
3	O-CH ₂ -CO-C(CH ₃) ₃	CH ₃	
4	H	CH ₂ -O-CH ₂ -C ₆ H ₅	
5	H	CH ₂ -S-CH ₃	
6	H	CH ₂ -SO ₂ -C ₆ H ₅	
7	H	CH ₂ -S-C ₆ H ₅	
8	O-CH ₃	CH ₂ -S-C ₆ H ₅	
9	O-CH ₂ -O-CH ₂ -C ₆ H ₅	CH ₃	
10	O-CH ₂ -O-C ₆ H ₅	CH ₃	
11	H	OH	

FormulationsEmulsion Concentrate

active compound	200 g/l
ethoxylated castor oil	100 g/l
tetrahydrofurfuryl alcohol	793 g/l

Biological Test Results

The fungicidal activity of the compositions and compounds of the invention is investigated by means of the following tests.

a) Activity Against Cereal Powdery Mildew *Erysiphe graminis* f.sp. *hordei* and f.sp. *tritici*)

This test measures the prophylactic activity of test compositions and test compounds applied as a foliar spray. Cereal seedlings (barley, cv Golden Promise; wheat, cv Kanzler) are grown to the 1 leaf stage. The plants are then sprayed with a solution of test compound in water, made up from a 5,000 ppm stock solution in acetone containing

5,000 ppm of TRITON® X 155 (a non-ionic polyoxyethylene ether surfactant). Plants are treated using an automated spray line with atomizing nozzles. The spray volume is 20 ml. One to three days after treatment, the seedlings are inoculated with powdery mildew by shaking stock culture plants with sporulating pathogen (barley - *Erysiphe graminis* f.sp. *hordei*; wheat - *Erysiphe graminis* f.sp. *tritici*) over them. Thereafter, the plants are kept for 3h without air movement in order to allow the spores to settle on the leaves. The plants are then kept in the greenhouse until symptoms occur. Assessment is based on the percentage of diseased leaf area compared with that on control leaves.

b) Activity Against Apple Powder Mildew *Podosphaera leucotricha*

This test measures the prophylactic activity of test compositions and test compounds, applied as a foliar spray. Apple seedlings (cv Morgenduft) are grown to the 6-7 leaf stage and then cut back to 3 leaves, taking off the oldest and youngest leaves. The plants are sprayed with a solution (20 ml) of test compound in water, made up from a 5,000 ppm stock solution in acetone containing 5,000 ppm of TRITON® X 155. The plants are treated using an automated spray line with atomizing nozzles. One to three days after treatment, the seedlings are inoculated with powdery mildew by shaking stock culture plants with sporulating pathogen over them. Thereafter, the plants are kept for 3 h without air movement. The plants are then kept in the greenhouse until symptoms occur. Assessment is based on the percentage of diseased leaf area of treated plants compared with that of control plants.

c) Activity Against Grapevine Powdery Mildew *Uncinula necator*

This test measures the direct protectant activity of test compositions and test compounds applied as foliar spray. Cuttings of grapevine (cv Müller-Thurgau) are grown to the 6-8 leaf stage and then cut back to 4 equally sized leaves. The plants are sprayed to run-off in a spray cabinet with a solution (20 ml) of test compound in water made up from a 5,000 ppm stock solution in acetone containing 5,000 ppm of TRITON® X 155. Two days after treatment, the cuttings are inoculated with conidia of *Uncinula necator* in a special spore setting tower. The spores are blown from freshly sporulating grape leaves (*U. necator* stock culture) into the upper hole of the settling tower and are allowed to settle on the leaves for 5 min. Then the plants are kept in a phytotron at 18°C night and 22°C day temperature at an interval of 12 h night and 12 h day. Illumination is accomplished by fluorescent tubes at 11,200 lux. Assessment is carried out after 21 days by visual inspection and based on the percentage of the diseased leaf area of the three youngest leaves compared with that on control plants. The results of the tests are set out in Table A and B below, in which the compounds are identified by reference to the preceding Compound Nos. allocated in Examples 1 to 9 above or to their Nos. in Tables IV to X. Absence of a rating indicates that none of the tests described above was carried out. A rating 0 indicates disease as untreated control, a rating 100 indicates no disease.

Table A

Comp.No.	<i>Erysiphe graminis</i>		<i>Podosphaera leucotricha</i>		<i>Uncinula necator</i>
	barley		wheat		
	100 ppm	100 ppm	100 ppm	200 ppm	
*1	100	100	96		84
*2	99	100	0		41
*3	0	0	0		
4	95	100	41		
5	94	99	41		
6	99	100			
*8	100	100	100		95

Table A

	Comp.No.	Erysiphe graminis		Podospaera Uncinula	
		barley	wheat	leucotricha	necator
		100 ppm	100 ppm	100 ppm	200 ppm
5	*9	0	70	95	
10	*10	85	100	44	88
15	*11	0	0	0	
	*12	23	0	0	
20	13	87	100		
	*14	0	36	0	
	*15	99	73	0	
25	16	100	94		
	17	25	5	77	
30	18	89	57	73	
	19	19	26	15	
	20	100	100	28	
35	21	9	19	15	
	23	100	100	100	
	24	94	100	53	
40	26	82	79	33	
	27	90	100	89	
	28	100	98		
45	29	99	93	97	
	31	99	100		
50	32	1	28	8	
	33	39	98		
55	34	0	0		

Table A

	Comp.No.	<i>Erysiphe graminis</i>		<i>Podosphaera leucotricha</i>	<i>Uncinula necator</i>
		barley	wheat	100 ppm	200 ppm
5	35	0	22	9	
	36	49	61		
15	37	70	37		
	38	42	77		
20	39	28	85		
	40	100	100		
	41	49	99		
25	43	23	49		
	44	89	38	10	
	46	100	100		
30	47	95	100		
	48	84	90	100	
35	50	4	6	94	
	51	51	25		
	52	0	0		
40	53	100	100		
	*54	100	100		
	56	100	100	11	
45	*57	99	100		
	*58	100	100		
50	*59	0	1		
	60	0	32		
	62	100	100		

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Table A

	Comp.No.	<i>Erysiphe graminis</i>		<i>Podosphaera leucotricha</i>	<i>Uncinula necator</i>
		barley	wheat	100 ppm	200 ppm
5					
10	*64	95	99	71	63
	*66	0	0	0	
15	*67	43	0	0	
	*68	0	0	0	
	*69	0	28	0	
20	*71	99	32	10	
	*72	55	72	0	
	*73	99	94	26	33
25	*74	0	0	16	
	*75	61	34	0	
30	76	33	57		
	*77	41	99	90	
	*78	0	85	0	
35	*79	0	0	0	
	80	76	100		
	82	100	100		
40	84	0	0		
	85	33	28		
45	86	0	17		
	91	93	100		
	*93	0	17		
50	*94	0	0		
	*95	91	0		

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Table A

	Comp.No.	<i>Erysiphe graminis</i>		<i>Podosphaera leucotricha</i>	<i>Uncinula necator</i>
		barley	wheat	100 ppm	200 ppm
5	*96	100	100	100	
	*97	100	100	100	
15	*98	100	100	100	
	*99	86	6	29	
20	*100	100	100	100	
	*101	100	100	87	
	*102	100	100	100	
25	*103	100	100	10	
	*104	100	14	27	
	*105	100	100	100	
30	*106	100	100		
	*107	0	21		
35	*108	100	100		
	*109	100	100		
	*110	100	100		
40	*111	95	100		
	*112	0	19		
	*113	0	28		
45	*114	0	17		
	*115	100	60		
50	*116	100	64		
	*117	100	100	6	

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Table A

	Comp.No.	<i>Erysiphe graminis</i>		<i>Podosphaera leucotricha</i>	<i>Uncinula necator</i>
		barley	wheat		
		100 ppm	100 ppm	100 ppm	200 ppm
5	*118	99	13	66	
10	*119	100	89	98	
	*120	100	89	46	
	*121	100	100	37	
20	*122	100	100	28	
	*123	0	44	9	
25	*124	100	100	89	
	*125	100	28	8	
	*126	100	100	100	
30	*127	100	100	100	
	*128	100	100	100	
35	*129	100	100	100	
	*130	0	78	0	
	*131	100	100	100	
40	*132	100	100	100	
	*133	100	100	100	
45	*134	100	100	100	
	*135	100	100	100	
	*136	100	100	100	
50	*137	100	100	97	
	*138	100	100	100	

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Table A

	Comp.No.	<i>Erysiphe graminis</i>		<i>Podosphaera leucotricha</i>	<i>Uncinula necator</i>
		barley	wheat		
		100 ppm	100 ppm	100 ppm	200 ppm
5	*139	100	100	100	
	*140	100	100	100	
15	*141	97	100	0	
	*142	97	100	53	
20	*143	100	100	100	
	*144	100	100	100	
25	*145	84	97	80	
	*146	65	91		
	*147	100	100		
30	*148	100	100		
	*149	39	66		
35	*161	48	77	100	
	*162	23	4	100	
	*163	97	90	7	
40	166	100	100	--	
	167	100	97	20	
	168	100	100	2	
45	169	100	100	0	
	170	100	100	100	
	171	97	100	0	
50	172	100	97	100	
	173	26	53	0	

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Table A

	Comp.No.	<i>Erysiphe graminis</i>		<i>Podosphaera leucotricha</i>	<i>Uncinula necator</i>
		barley	wheat	100 ppm	200 ppm
5	174	100	100	98	
	175	100	100	100	
15	176	0	0	8	
	177	52	0	0	
20	178	100	100	100	
	180	95	19	--	
	181	5	0	6	
25	182	100	93	0	
	183	100	74	0	
	184	100	100	100	
30	185	0	0	0	
	186	0	100	100	
35	189	100	100	100	
	190	98	8	68	
	191	100	100	99	
40	196	0	82	87	
	197	71	78	1	
	199	0	0	--	
45	200	100	100	41	
	201	98	0	--	
50	202	0	92	92	

Table A

Comp.No.	Erysiphe graminis		Podospaera leucotricha		Uncinula necator
	barley	wheat	100 ppm	200 ppm	
100 ppm					
100 ppm					
100 ppm					
200 ppm					

* indicates the infection with Erysiphe graminis and Podospaera leucotricha was carried out 72 h after treatment

Table B

Compound	Erysiphe graminis		Podospaera
Table/No.	barley	wheat	leucotricha
	100 ppm	100 ppm	100 ppm
IV/1	100	100	---
2	100	100	0
3	100	100	48
4	51	100	5
5	11	25	---
6	26	23	---
7	100	100	---
8	95	92	---
9	98	100	---
10	100	100	0
11	100	100	6

Table B (continued)

Erysiphe graminis Podospaera

EP 0 727 141 A2

Compound Table/No.	barley 100 ppm	wheat 100 ppm	leucotricha 100 ppm
5			
12	96	100	0
13	100	90	0
10			
V/1	100	100	97
2	100	99	63
3	100	100	25
15			
4	100	100	0
VI/1	100	100	100
20			
2	100	100	100
3	100	100	100
4	100	100	100
25			
5	100	100	100
6	100	100	100
7	100	45	0
8	100	100	100
30			
9	74	23	6
10	100	100	96
11	100	100	100
35			
12	100	0	0
VI/13	100	100	100
40			
16	100	100	100
17	100	58	100
18	100	97	100
45			
19	100	100	100
20	100	100	100
21	100	100	38

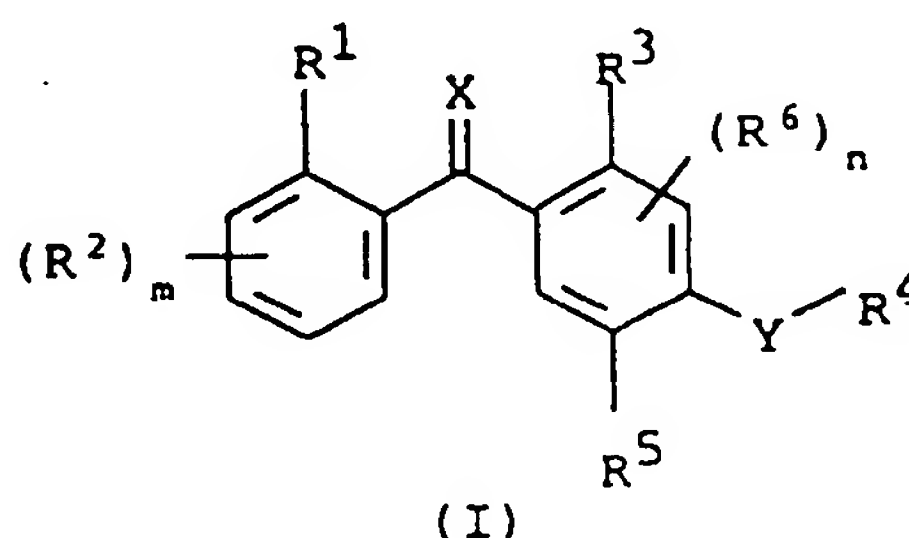
Table B (continued)

Erisyphe graminis Podospaera

Compound Table/No.	barley 100 ppm	wheat 100 ppm	leucotricha 100 ppm
22	100	100	100
23	100	95	19
25	100	100	100
VII/3	100	100	93
4	100	100	100
IX/1	100	100	100

Claims

1. A method for the control of a phytopathogenic fungus or a disease caused thereby which comprises contacting said fungus with a fungicidally effective amount of a compound of formula I



wherein

R¹ represents a halogen atom, an optionally substituted alkyl or alkoxy group, a cyano or a nitro group;
m is 0 or an integer of 1, 2, 3 or 4;

R² independently represents a halogen atom, an optionally substituted alkyl or alkoxy group, a nitro group or when R¹ and R² are on adjacent carbon atoms, R¹ and R² may be taken together to represent an optionally substituted -CH=CH-CH=CH-, alkylene or oxyalkyleneoxy group;

R³ represents a hydrogen or halogen atom, a cyano, carboxy, hydroxy or nitro group or an optionally substituted alkyl, alkoxy, alkenyl, alkylthio, alkylsulphinyl, alkylsulphonyl or amino group;

R⁴ represents a hydrogen atom or an optionally substituted alkyl or acyl group;

R⁵ represents a hydrogen or a halogen atom or a nitro group, an optionally substituted alkyl, alkoxy, alkenyloxy, alkynyloxy, alkylthio, cycloalkyl, cycloalkyloxy, hydroxy, aryloxy, trialkylsilyloxy, -ONa, -OK, -OC(O)R⁷, -OCHR⁸C(O)R⁷, -OC(O)NR⁸R⁹, -S(O)₂R⁸, -OS(O)₂NR⁸R⁹, -OP(X¹)(OR⁸)OR⁹, -OP(X¹)(R⁸)R⁹, -S(O)R⁸ or -S(O)₂R⁸ group or R⁴ and R⁵ may be taken together to represent an optionally substituted alkylene or alkyleneoxy chain;

n is 0 or an integer of 1 or 2;

R⁶ independently represents a halogen atom, an optionally substituted alkyl, alkenyl, alkynyl, alkoxy, alkenyloxy, alkynyloxy, cycloalkyl, cycloalkoxy, hydroxy or OC(O)R¹⁰ group or when R⁵ and R⁶ are on adjacent carbon atoms, R⁵R⁶ may be taken together to represent an optionally substituted -CH=CH-CH=CH- or oxyalkyleneoxy

chain;

R⁷ represents a hydrogen atom or an optionally substituted alkyl or alkoxy group;

R⁸, R⁹ and R¹⁰ independently represent a hydrogen atom or an optionally substituted alkyl, aryl or aralkyl group, or, R⁸ and R⁹ may be taken together to represent an alkylene chain which may be interrupted by an

oxygen or nitrogen atom;

X represents an oxygen atom, a sulphur atom or an NOR group;

X¹ represents an oxygen atom or a sulphur atom;

Y represents an oxygen atom, a sulphur atom, a sulphonyl or a sulphinyl group; and

R represents a hydrogen atom or an optionally substituted alkyl, aralkyl, aryl, or acyl group.

2. The method according to claim 1, wherein the formula I compound is selected from the group consisting of

2,3,5,6-tetramethyl-4',5',6'-trimethoxy-2'-methylbenzophenone;

2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone-O-methyloxime;

2,6-dichloro-5'-t-butoxy-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-5',6'-di-n-butoxy-4'-methoxy-2'-methylbenzophenone;

2'-benzoylmethoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;

2'-allyloxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;

2'-benzyloxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;

2'-butoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;

2'-cyclohexylmethoxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;

2'-cyclopentyloxy-2,6-dichloro-3',4'-dimethoxy-6'-methylbenzophenone;

2,6-dichloro-2',3',4'-trimethoxy-6'-methylbenzophenone;

2,6-dichloro-2'-ethoxy-3',4'-dimethoxy-6'-methylbenzophenone;

2,6-dichloro-2'-heptyloxy-3',4'-dimethoxy-6'-methylbenzophenone;

2,6-dichloro-2'-hexyloxy-3',4'-dimethoxy-6'-methylbenzophenone;

2,6-dichloro-3',4'-dimethoxy-2'-(2-methoxy-ethoxy)-6'-methylbenzophenone;

2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-(3-methylbutoxy)-benzophenone;

2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-(prop-2-ynyloxy)-benzophenone;

2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-pentyloxybenzophenone;

2,6-dichloro-3',4'-dimethoxy-6'-methyl-2'-propoxybenzophenone;

2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone;

2,6-dichloro-4'-methoxy-2'-methyl-5'-(3-methylbutoxy)-benzophenone;

2,6-dichloro-4'-methoxy-2'-methyl-5'-(prop-2-ynyloxy)-benzophenone;

2,6-dichloro-4'-methoxy-2'-methyl-5'-octyloxybenzophenone;

2,6-dichloro-4'-methoxy-2'-methyl-5'-pentyloxybenzophenone;

2,6-dichloro-4'-methoxy-2'-methyl-5'-propoxybenzophenone;

2,6-dichloro-4'-methoxy-2'-methyl-5'-trimethylsilylmethoxybenzophenone;

2,6-dichloro-5'-(1-ethyl-propoxy)-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-5'-difluoromethoxy-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-5'-ethoxy-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-5'-heptyloxy-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-5'-hexyloxy-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-4',5'-dimethoxy-2'-methylbenzophenone-O-n-propyloxime

2,6-dichloro-5'-isobutoxy-4'-methoxy-2'-methylbenzophenone;

2,6-dichloro-5'-isopropoxy-4'-methoxy-2'-methylbenzophenone;

5'-butoxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;

5'-cyclohexylmethoxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;

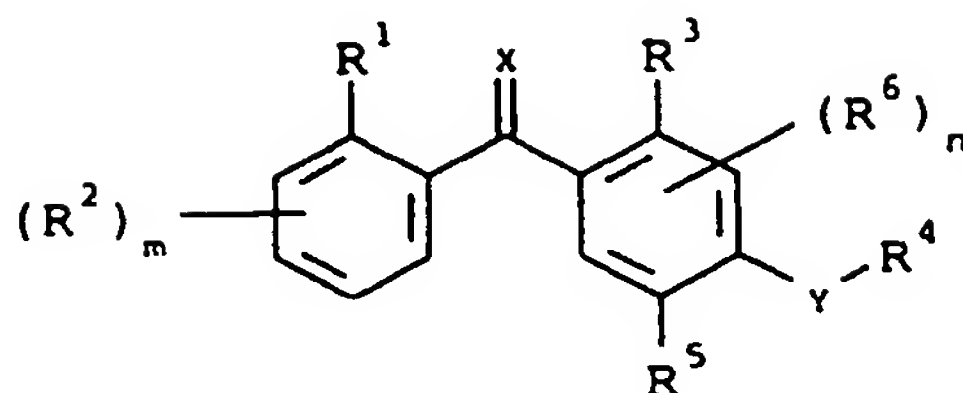
5'-cyclohexyloxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;

5'-cyclopentyloxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;

5'-cyclopropylmethoxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;

5'-decyloxy-2,6-dichloro-4'-methoxy-2'-methylbenzophenone;

3. A compound of formula Ia



(Ia)

wherein

R¹ represents a halogen atom, an optionally substituted alkyl group or a cyano group;

m is an integer of 1, 2, 3 or 4;

R² independently represents a halogen atom, an optionally substituted alkyl or alkoxy group or when R¹ and R² are attached to adjacent carbon atoms, R¹ and R² may be taken together to represent an optionally substituted -CH=CH-CH=CH- or alkylene or oxyalkyleneoxy group;

R³ represents a hydrogen or halogen atom, an optionally substituted alkyl, alkoxy, alkenyl, alkylthio, alkylsulphanyl, alkylsulphonyl, cyano, carboxy, hydroxy, nitro, or an optionally substituted amino group;

R⁴ represents an optionally substituted alkyl or acyl group;

R⁵ represents a halogen atom, an optionally substituted alkoxy, alkenyloxy, alkynyloxy, alkylthio, cycloalkyl, cycloalkyloxy group, trialkylsilyloxy group, -ONa, -OK, -OC(O)R⁷, -OCHR⁸C(O)R⁷, -OC(O)NR⁸R⁹, -S(O)₂R⁸, OS(O)₂NR⁸R⁹, -OP(X¹)(OR⁸)OR⁹, -OP(X¹)(R⁸)R⁹, -S(O)R⁸ or -S(O)₂R⁸ group or R⁴ and R⁵ may be taken together to represent an optionally substituted alkylene or alkyleneoxy chain;

n is 0, or an integer of 1 or 2;

R⁶ independently represents an optionally substituted alkoxy group, a hydroxy or an -OC(O)R¹⁰ group or when R⁶ and R⁶ are attached to adjacent carbon atoms, R⁶R⁶ may be taken together to represent -CH=CH-CH=CH- or an optionally substituted oxyalkyleneoxy chain;

R⁷ represents a hydrogen atom or an optionally substituted alkyl or alkoxy group;

R⁸, R⁹ and R¹⁰ independently represent a hydrogen atom or an alkyl group or R⁸ and R⁹ may be taken together to represent an alkylene chain optionally interrupted by an oxygen or nitrogen atom;

X represents an oxygen atom, a sulphur atom or an NOR group;

X¹ represents an oxygen atom or a sulphur atom;

Y represents an oxygen atom, a sulphur atom a sulphonyl or a sulphinyl group; and

R represents a hydrogen atom or an optionally substituted alkyl, aralkyl, aryl or acyl group;

with the provisos that when X is O or S and:

(i) when R¹ represents a halogen atom, then R² must be other than a halogen atom or no more than one alkyl or alkoxy group,

(ii) when R¹ represents an alkyl group, then R² must be other than alkyl;

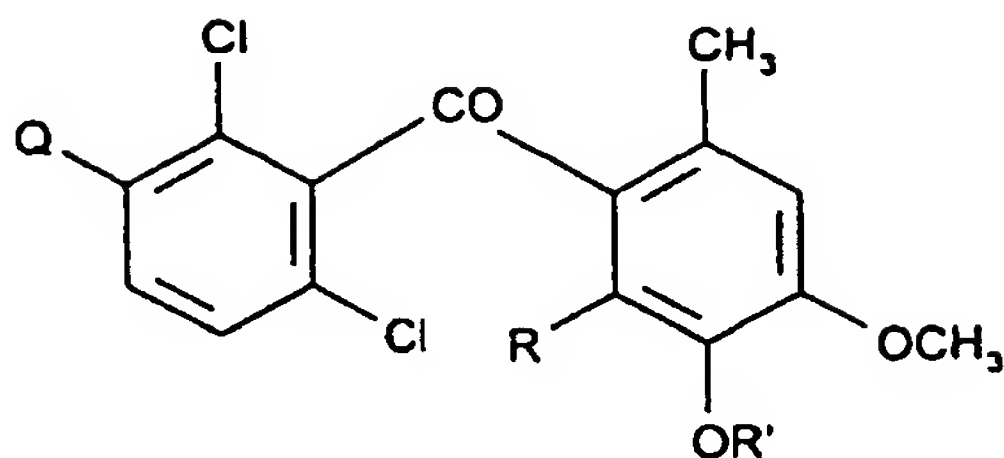
(iii) when m is 1, then R² must be other than an alkoxy group;

(iv) when R³ represents a substituted alkenyl group, then R³ must be substituted with other than an alkoxy or acyl group;

(v) when R³ represents a haloalkyl group, then R¹ and R² must be other than a haloalkyl group; and

(vi) when Y represents an oxygen atom, then R³ and R⁵ must both be other than a hydrogen atom and n must be an integer of 1 or 2.

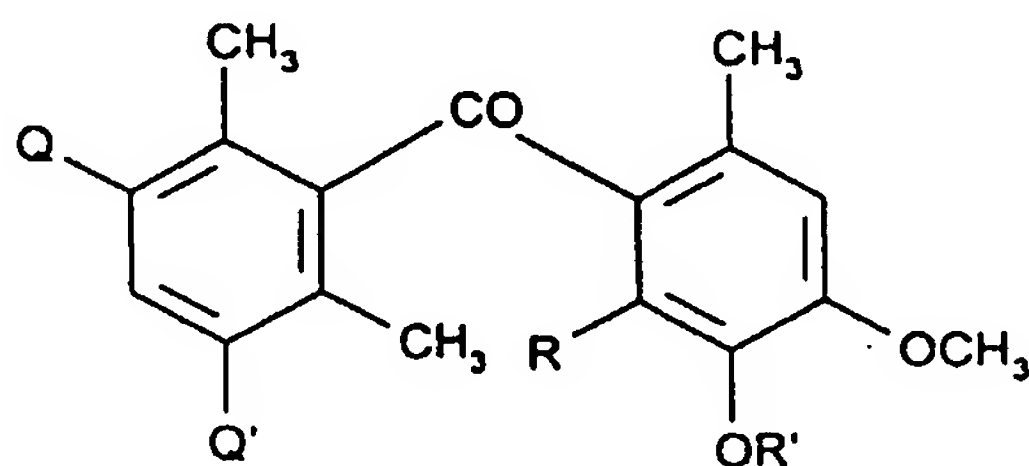
4. A compound of formula



(I B)

wherein Q represents a hydrogen or a chlorine atom; R represents a hydrogen atom, a C₃-C₈-cycloalkoxy group or a C₁-C₈-alkoxy group optionally substituted with one or more fluorine atoms or one phenyl, phenoxy, phenylthio or benzyloxy group, wherein the phenyl moiety may be substituted by halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl and/or trifluoromethoxy; and R' represents hydrogen or C₁-C₁₀-alkyl optionally substituted with one or more halogen, C₁-C₄-alkoxy, phenyl, phenoxy or phenylthio groups, wherein the phenyl moiety may be substituted by halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl or trifluoromethoxy; with the proviso, that when Q and R represent hydrogen, then R' must be other than methyl.

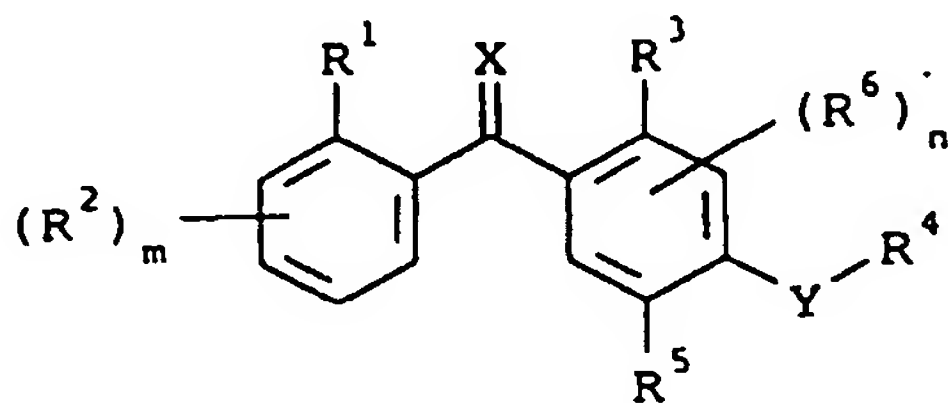
5. A compound of formula



(I C)

wherein Q and Q' independently represent a hydrogen atom or methyl group; R represents a hydrogen atom, a C₃-C₈-cycloalkoxy group or a C₁-C₈-alkoxy group optionally substituted by one or more fluorine atoms, a phenyl, phenoxy, phenylthio or benzyloxy group, wherein the phenyl moiety may be substituted with one or more halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl or trifluoromethoxy groups; and R' represents hydrogen or C₁-C₁₀-alkyl optionally substituted with one or more halogen, C₁-C₄-alkoxy, phenyl, phenoxy or phenylthio groups, wherein the phenyl moiety may be substituted with one or more halogen, C₁-C₄-alkyl, C₁-C₄-alkoxy, trifluoromethyl or trifluoromethoxy groups.

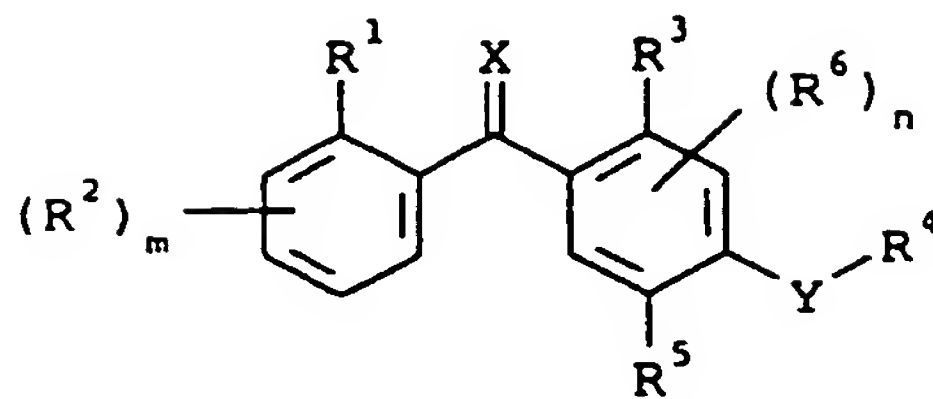
6. A method for the protection of a plant from the damage caused by a phytopathogenic fungus or a disease caused thereby which comprises applying to the plant or seed or tuber thereof or the locus in which said plant, seed or tuber is growing or about to be grown a fungicidally effective amount of a compound of formula I



(I)

7. A fungicidal composition which comprises an agriculturally acceptable carrier and a fungicidally acceptable amount

of a compound of formula I

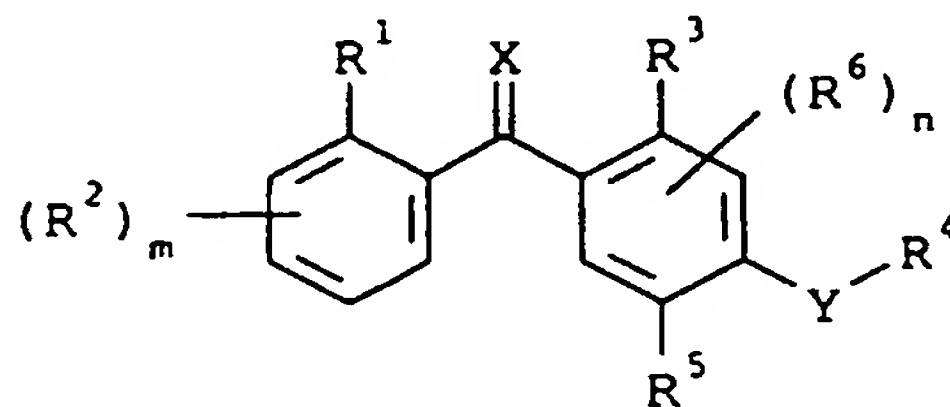


(I)

wherein X, Y, R¹, R², R³, R⁴, R⁵, R⁶, m and n are as defined in claim 1.

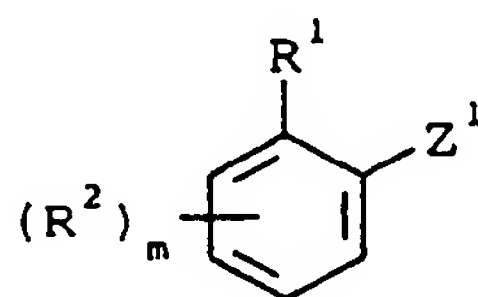
8. The composition according to claim 7 wherein X is an oxygen atom or a group NOR; Y is an oxygen atom; R¹, R², R³ and R⁴ are each independently a halogen atom or a C₁-C₆alkyl group; R⁵ and R⁶ are each independently an optionally substituted C₁-C₆alkoxy group; m is an integer of 1 or 3 and n is 0 or an integer of 1.

9. A process for the preparation of a compound of formula I



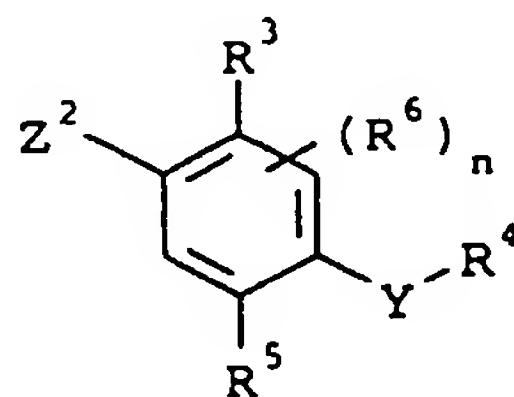
(I)

wherein X is an oxygen atom and R¹, R², R³, R⁴, R⁵, R⁶, Y, m and n are as defined in claim 1 which comprises reacting a compound of formula II



(II)

with a compound of formula III

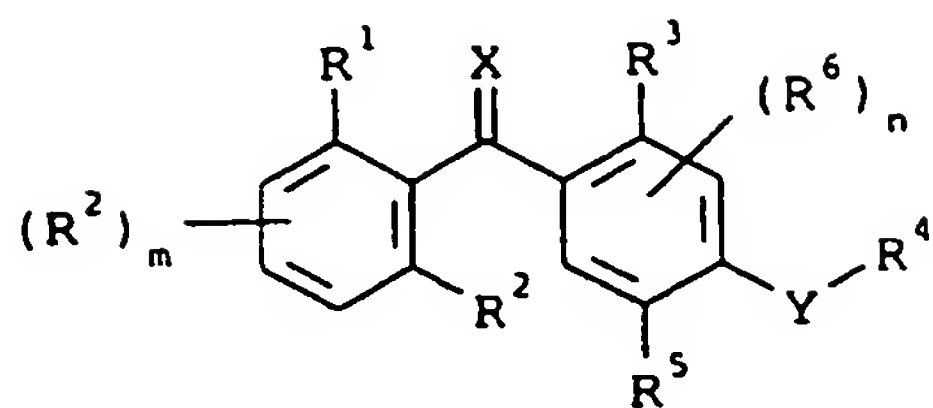


(III)

wherein

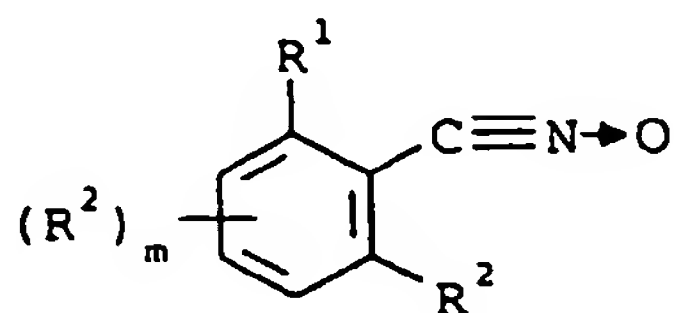
R¹, R², R³, R⁴, R⁵, R⁶, Y, m and n are as defined for formula I and one of Z¹ and Z² represents a hydrogen atom and the other represents the group COCl or one represents a magnesium halide group MgHal, wherein Hal represents a bromine or iodine atom, and the other represents COCl.

10. A process for the preparation of a compound of formula Ib



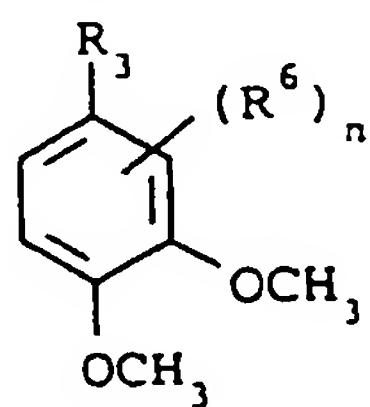
(Ib)

wherein X represents a group NOH; m is 0 or an integer of 1, 2 or 3; Y is an oxygen atom; R4 is methyl; R5 is methoxy, and R3, R6 and n are as defined in claim 1 which comprises reacting a compound of formula VI



(VI)

with at least one molar equivalent of a compound of formula VII



(VII)

in the presence of at least one molar equivalent of aluminum chloride and a nonpolar solvent to form an intermediate and hydrolyzing said intermediate in the presence of an acid and water to yield the product formula Ib compound.

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